TABLE OF CONTENTS

I. EXTENT OF INVESTIGATION

II. DATA EVALUATION

1. Evaluation of Sampling Data from Media of Concern
2. Evaluation of Analytical Methods
3. Evaluation of Data Qualifiers
4. Evaluation of Quantitation Limits
   - *4.1 Estimated Values Near the Limit of Detection*
   - *4.2 Censoring of Data*
   - *4.3 Treatment of Non-Detected Analytical Results*

III. DATA SCREENING PROCEDURES

1. Frequency of Detection
2. Blank Contamination
3. Tentatively Identified Compounds (TICs)
4. Risk-Based Screening

IV. CALCULATING THE CONCENTRATION TERM

1. General Statistical Considerations
   - *1.1 Random vs. Purposeful (Judgmental) Sampling Designs*
   - *1.2 Calculation of a 95% Upper Confidence Limit (UCL) on the Mean*
2. Evaluation of Groundwater Data
   - *2.1 Estimating Representative Concentrations*
   - *2.2 Filtering Groundwater Samples*
3. Evaluation of Soil Data
   - *3.1 Exposure Area*
     - 3.1.1 Residential Scenarios
     - 3.1.2 Commercial/Industrial Scenarios
   - *3.2 Soil Depth*
     - 3.2.1 Residential Properties
     - 3.2.2 Non-Residential Properties
     - 3.2.3 Appropriate Soil Depth for Use in Statistical Evaluations
   - *3.3 Evaluation of the Soil-to-Groundwater Pathway*

V. ENGINEERING AND INSTITUTIONAL CONTROLS

VI. CONSIDERATION OF MAXIMUM CONTAMINANT LEVELS (MCLs), PRACTICAL QUANTITATION LIMITS (PQLs), AND SITE-SPECIFIC BACKGROUND IN THE CUMULATIVE RISK EVALUATION UNDER STANDARD 3

1. Maximum Contaminant Levels (MCLs)

2. Practical Quantitation Limits (PQLs)
3. Background Determination

VII. EVALUATION OF THE DERMAL EXPOSURE PATHWAY

1. Toxicity Values for Dermal Exposure
2. Dermal Relative Absorption Fraction
3. Procedure for Calculating Cleanup Levels and Protective of Dermal Contact with Soil

VIII. TARGET CANCER RISK LEVELS AND HAZARD QUOTIENT/INDEX

1. Evaluation of a Single Contaminant in a Medium in Accordance with the Requirements Specified fro Standard 3
2. Evaluation of Multiple Contaminants in a Medium in Accordance with the Requirements Specified for Standard 3

IX. CALCULATING A SOIL MSC VALUE UNDER RISK REDUCTION STANDARD NUMBER 2

X. CALCULATING A SOIL MEDIUM SPECIFIC CONCENTRATION (MSG) VALUE UNDER RISK REDUCTION STANDARD NUMBER 3

1. Calculating Inhalation Risk
   1.1 Adjustment for Less than 24-Hour
2. Additional Exposure Scenarios Routinely Considered Under Risk Reduction Standard Number 3
   2.1 Trespasser

Attachment A - Recommended Data Reporting Procedures

Table A.1 - Laboratory Quality Control Data

Attachment B - General Discussion of Analytical Terms and Issues

1. Detection Limits and Quantitation Limits
   1.1 Definition of Reporting Terms
      1.1.1 Instrument Detection limit
      1.1.2 Method Detection Limit
      1.1.3 Method Quantitation Limit
      1.1.4 Practical Quantitation Limit (PQL) as Defined in 30 TAC 335
      1.1.5 Practical Quantitation Limit (PQL) as Defined in SW-846
      1.1.6 Sample Quantitation Limit
2. Selecting the Correct Analytical Procedure
3. Qualifying Data
4. Reviewing Data

Attachment C: Dermal and GI Absorption Factors

Updated September 18, 1998 and contained in separate file named attach_c.pdf.

Attachment D: Equations for Calculating Soil Medium Specific Concentrations (MSCs)

Table D1 Default Exposure Factors for Use in Soil MSC Equations

Attachment E: Chemical/Physical Properties

Updated September 18, 1998 and contained in separate file named attach_c.pdf.

The following updated tables are contained in separate files.

Updated Examples of Standard No. 2, Appendix II Medium-Specific Concentration (MSCs) (Last update September 18, 1998)(file name is rrs2-web.pdf)

Risk Based Screening Values (Last update Septembe 18, 1998)(file name is scrn-web.pdf)

Toxicity Factors (Last update September 18, 1998)(file name is tox-web.pdf)

Texas Natural Resource Conservation Commission

INTEROFFICE MEMORANDUM

To: Remediation Division Staff **Date:** July 23, 1998

From: Ronald R. Pedde, P. E., Division Director
Remediation Division
Office of Waste Management

Subject: Implementation of the Existing Risk Reduction Rule

The information contained in this interoffice memorandum is provided to assist agency staff in reviewing documents submitted under the existing Risk Reduction Rule codified in Subchapters A and S of 30 Texas Administrative Code (TAC) Chapter 335. The goal of this memorandum is to provide a consistent framework upon which to evaluate human health risk and to establish cleanup levels for all contaminated sites subject to the existing Risk Reduction Rule. This framework should ultimately serve to reduce disagreements and time delays, to enhance consistency among sites, to ensure that flexibility is maximized in all cases where warranted, and to allow for the more efficient and cost-effective utilization of resources by both the regulated community and the agency.

The existing Risk Reduction Rule codified in 1993 in Subchapters A and S of 30 TAC Chapter 335 (hereafter referred to as the existing rule) governs closure, corrective action, and remediation of facilities or areas containing industrial solid waste, municipal hazardous waste, or contaminated media. This rule, when adopted in 1993, recognized for the first time that limited quantities of contaminants could remain in soil or groundwater and not present an unacceptable threat to human health or the environment. The existing rule was designed with the goal of increasing the efficiency and timeliness of environmental cleanup activities by streamlining the process for review and approval of closure and remediation plans. To this end, this rule established generic cleanup levels, as well as standardized risk assessment procedures that could be used to develop site-specific cleanup levels. While this rule represented a significant step toward the adoption of a consistent risk-based approach for determining the extent and type of closure or remediation which is necessary at contaminated sites, experience gained over time has indicated that several areas are in need of further clarification. Many sections of the existing rule are performance-based and lack adequate specificity as to how conformance should be demonstrated. Providing more specific guidance is critical for both the agency and the regulated community since the lack of specificity has resulted in disagreements, time delays, cost increases, and potentially unjustifiable differences among sites. This, in turn, has posed a hindrance to the prompt remediation of contaminated sites.

Several of the critical issues requiring more specific guidance are discussed in this memorandum. Some of the issues discussed here impact all three standards of the existing rule (e.g., calculation of the concentration term), while others may impact only a specific standard (e.g., consideration of maximum contaminant levels (MCLs) in the baseline risk assessment required under Standard 3). Many of the issues discussed in this memorandum affect Standard 3 due to the lack of detail provided in the rule regarding how the risk-based determinations required by this Standard are to be performed. For example, one of the requirements of Standard 3 specified in the rule (§335.553(b)(2)) is that "The

person shall prepare a baseline risk assessment report which describes the potential adverse effects under both current and future conditions caused by the release of contaminants in the absence of any actions to control or mitigate the release." However, with the exception of specifying standard exposure factors in Table 1 of §335.553, the rule does not address how to conduct a baseline risk assessment. The commission attempted to establish a generic framework for conducting baseline risk assessments by stating in the preamble of the final rule that it intended to use Part A, Volume 1 of the *Risk Assessment Guidance for Superfund (RAGS)* (USEPA, 1989a) until such time that the commission developed additional guidance in this area. Over time, it has become evident that relying solely on *RAGS* (USEPA, 1989a) is not sufficient due to the fact that much of the information provided in *RAGS* (USEPA, 1989a) is now out of date, and in many cases, is too vague and subjective to be used without additional guidance. One of the agency's greatest concerns is that the lack of more specific guidance has lead to inconsistencies across sites. For example, while the existing rule requires that media cleanup levels be calculated for carcinogens and non-carcinogens present at the site (§335.563), the rule also states in §335.563 (h) that media cleanup levels for groundwater that is a current or potential source of drinking water shall not exceed maximum contaminant levels (MCLs) promulgated under the Safe Drinking Water Act. This has resulted in confusion over the need to calculate cancer risks and noncancer hazards for contaminants meeting federal MCLs. While the agency has made a determination that it is unnecessary to calculate risk or hazard for contaminants with MCLs promulgated under the Safe Drinking Water Act, it has been difficult to communicate this information effectively to all agency staff who are performing reviews of contaminated sites under the existing rule. Clearly a memorandum such as this is necessary to effectively communicate this and other policy determinations that have been made to agency staff.

The guidance discussed in this memorandum applies solely to contaminated sites subject to the existing rule promulgated in 1993. The agency is currently in the process of proposing a modified rule (the Texas Risk Reduction Program (TRRP) Rule) which will establish a consistent risk-based corrective action approach for all Office of Waste Management program areas. As of May 15, 1998, the Proposed TRRP Rule (30 TAC 350) was published in the Texas Register.

In conclusion, the goal of this memorandum is to provide a consistent, defensible and reasonable framework upon which to evaluate human health risk and to establish media cleanup levels for all contaminated sites subject to the existing rule. This framework should ultimately serve to reduce disagreements and time delays, to enhance consistency among sites, to ensure that flexibility is maximized when warranted, and to allow for the more efficient and cost-effective utilization of resources. <u>All agency project coordinators should adhere to the guidance and rule interpretations provided in this memorandum, although alternative methodologies or inputs may be suggested and may ultimately be determined to be acceptable to the agency when site-specific conditions or credible authority warrant such deviation.</u> Reasonableness should be exercised in the implementation of the guidance provided in this memorandum. The intent of this memorandum is not to discount existing data but rather to ensure that the agency receives data of adequate and known quality for decision-making purposes. For example, rather than discounting entire data sets, it may be appropriate to request collection of additional samples from key areas of the site and require that such new data satisfy the guidance outlined in this memorandum. Acceptance or denial of alternative methodologies proposed by responsible parties which deviate from the recommendations provided in this memorandum should be coordinated with the Toxicology and Risk Assessment (TARA) Section.

The degree of involvement by TARA staff will be commensurate with the level of complexity of the issue. As additional issues are identified and solutions are developed, the agency may issue additional guidance to further clarify the existing rule.

Finally, since the adoption of the existing rule, evaluation tools have been developed to help persons determine if, in accordance with §335.556(b) or 335.563(j)(3), more stringent media cleanup levels are necessary to protect environmental receptors. The evaluation tools which are currently available include: (1) the "Guidance for Conducting Ecological Risk Assessments Under the Texas Risk Reduction Program;" and (2) the "Exclusion Criteria Checklist." The former is a draft guidance document which describes a three-tiered process for conducting ecological risk assessments (ERAs). It is available through TNRCC Publications as Document No. RG-263 or at TNRCC's web site on the internet at: **www.tnrcc.state.tx.us/waste/ecological**. This document is currently being revised. The latter document is the revised Tier 1 portion of the ERA guidance and is a formal part of the proposed TRRP rule. Exclusion criteria refer to those conditions at an affected property which preclude the need for an ERA because of incomplete ecological exposure pathways. This checklist is available through the Remediation Division. In all cases, please ensure that the most current version of each of the aforementioned documents is used.

I. EXTENT OF INVESTIGATION

Subsections 335.553(a) and (b)(1) of the existing rule require persons to submit information which characterizes the nature, extent, direction, rate of movement, volume, composition and concentration of contaminants in environmental media for all three risk reduction standards. Given the requirement for deed notice specified in §335.55(b) for Remedy Standard 3 when contaminants are left in soil or groundwater at concentrations in excess of background levels, it is necessary to investigate the extent of contamination in the lateral and vertical directions to background concentrations under all three standards of the existing rule.

An exception to this requirement is the Voluntary Cleanup Program, which in accordance with §333.7(a) requires an investigation of the full nature and extent of contamination in all media unless the person demonstrates to the satisfaction of the executive director that site conditions warrant a focused investigation. However, even in this instance, concentrations should be determined to background levels in the vertical direction in order to determine if contamination present in the soil has reached groundwater. Another exception is the case-specific situation of commingled plumes. If it is unlikely that delineation to background for a release from a unit can be determined because of commingling of that release with other releases or other site-wide contamination, the investigation may be limited to health-based values provided a decreasing trend away from the source can be shown and, if applicable, off-site property is deed recorded.

In accordance with §335.354(d) of the existing rule, for Remedy Standard 1, if the practical quantitation limit (PQL, as defined in Attachment B) is greater than background, then the PQL rather than background shall be used as the cleanup level. As presented in §335.555(d)(1) for Remedy Standard 2 and in §335.563(j)(1) for Remedy Standard 3, if the PQL or the background concentration for a contaminant is greater than the risk-based cleanup level, then the greater of the PQL or background shall become the cleanup level. In the same manner, if the PQL is higher than the

background concentration, then the PQL should be used for purposes of determining the extent of contamination. As discussed in Section II.2, the standard method which achieves the lowest PQL should be used for the sampling locations used to demonstrate the extent of contamination.

II. DATA EVALUATION

It is essential that agency staff evaluate the analytical data submitted for a site to ensure that contaminants were not inappropriately eliminated from consideration under the existing rule. It is equally important that agency staff understand the limitations of the analytical data prior to approving the use of such data under any of the three standards of the existing rule. The following data evaluation steps should be followed to determine whether data collection and analyses are adequate to characterize the nature and extent of contamination at the site for subsequent evaluation under Standards 1, 2, or 3 of the existing rule:

- Evaluate sampling data from each medium of concern;
- Evaluate analytical methods used and associated method detection limits (MDLs);
- Evaluate data with respect to data qualifiers and codes;
- Evaluate quality of data with respect to sample quantitation limits (SQLs);
- Evaluate data with respect to frequency of detection;
- Evaluate data with respect to blank contamination;
- Evaluate data with respect to tentatively identified compounds (TICs);
- Evaluate risk-based screening approaches used for limiting the list of contaminants to be carried through a quantitative risk assessment.

Procedures for evaluating data quality with respect to the data comparability, analytical methods, SQLs, and data quality indicators are presented in Section II. Procedures for evaluating the data with respect to frequency of detection, blank contamination, tentatively identified compounds (TICs), and risk-based screening are presented in Section III (Data Screening Procedures). In addition, recommended data reporting procedures are presented in Attachment A.

II.1. Evaluation of Sampling Data From Media of Concern

For each medium of concern, agency staff should ensure that data from all available sources have been identified and evaluated, including preliminary site assessments, remedial investigations and alternative screening activities, and ongoing site characterizations.

II.2 Evaluation of Analytical Methods

The choice of analytical methods is critical to providing high quality data for use under Standards 1, 2, and 3 of the existing rule. Based on available information regarding past and present site activities, the project coordinator should make a determination as to whether the analytical methods used provided adequate data, including adequate quantitation limits, on the appropriate contaminants for the site. A quantitation limit is considered adequate when it is at or below the levels of concern specified for the applicable standard of the existing rule (i.e., below background concentrations for Standard 1 and below applicable health-based concentrations of concern (GW-Res, GW-Ind, GWP-

Res, GWP-Ind, SAI-Res, and SAI-Ind) provided in the table entitled "Updated Examples of Standard No. 2, Appendix II Medium-Specific Concentrations" located on TNRCC's web site on the internet at: **www:tnrcc.state.tx.us/waste (hereafter referred to as health-based concentrations of concern)**)) for Standards 2 and 3. In reviewing analytical data submitted to the agency, project coordinators should document the level of concern for each contaminant (i.e., the background concentration for Standard 1 and the health-based concentration of concern for Standards 2 and 3) and compare those levels to the laboratory's practical quantitation limits (PQL - i.e., the lowest non-zero standard in the laboratory's calibration curve). For a contaminant which has a level of concern below the laboratory's PQLs, the project coordinator should verify that the analytical method used is **the most sensitive standard available method for the contaminant in the specified medium**. This is essential given that the existing rule allows persons responding to rule to use the laboratory's PQL as the cleanup level when the background concentration (Standard 1) or the health-based level of concern (Standards 2 and 3) is below the PQL **AND** the person can demonstrate that lower levels of quantitation are not possible using **standard available methods**. The project coordinator should use USEPA's *Environmental Monitoring Methods Index* when evaluating the sensitivity of a method or a PQL. If the index lists only an MDL for the matrix, a PQL for a method can be estimated by multiplying the MDL by 5 for water matrix and 10 for soil matrix for the purpose of comparing methods. However, the PQL must ultimately be established by the laboratory and be equal to the concentration of the lowest non-zero standard in the laboratory's calibration curve. An evaluation of the laboratory's PQL should be made before the PQL is used as a cleanup level.

Due to the fact that different laboratories may achieve different levels of quantitation using identical analytical methods, it is critical that evaluation of the adequacy of the analytical methods used be based on the performance for the specific laboratory conducting the analysis. Factors which contribute to such differences between laboratories include greater analytical expertise and better instrumentation. All evaluations of the adequacy of analytical methods should include, at a minimum, consideration of the following:

- Did the laboratory use the most sensitive method?
- Are the laboratory PQLs (as defined in Attachment B of this memorandum) for the selected analytical method below the level of concern for each contaminant?
- Is sufficient quality control (QC) documentation available, or on file in the laboratory, to support the laboratory's performance at that level of quantitation, (e.g., the results of the laboratory's initial demonstration of proficiency for that method or the initial calibration results for that method that demonstrates the sensitivity which the laboratory can achieve using that method)?

Additionally, the project coordinator should ensure that the appropriate types of data have been reported. Appropriate types of data include data generated from a standard set of chemical-specific methods with well documented and traceable quality assurance/quality control procedures. Standard chemical-specific methods include SW-846 Methods, USEPA 600 Series Methods, USEPA Contract Laboratory Program Methods, and others that provide identification and quantification for detected contaminants and provide adequate sensitivity to meet the project objectives (i.e., the PQL, as defined in Attachment B, is at or below the health-based concentration of concern for the contaminant).

In cases where workplans are submitted to the agency for review and comment prior to the collection of analytical data, project coordinators should document the levels of concern for all contaminants to be analyzed for and should compare those levels to the laboratory's PQL and the MDL. Ideally, the MDL for the proposed analytical method should be no greater than 20% of the applicable levels of concern in order to increase the likelihood that the SQLs will be at or below those levels (USEPA 1992a). Additionally, it is critical that the laboratory's PQL be at or below the applicable level of concern for a specific contaminant.

Additional information concerning quantitation limits and qualified data is provided in Attachment B of this memorandum. General information on industry-specific analytes of concern is provided in Appendix II of the *Guidance for Data Useability in Risk Assessment* (USEPA, 1992a). Guidance on selecting the analytical method, sample collection techniques, and analytical methodologies described in the most recent version of the United States Environmental Protection Agency (USEPA) *SW-846, Test Methods for Evaluating Solid Waste* should be used when available. The USEPA's *Environmental Monitoring Methods Index* should be used when comparing analytical methods. This index will be made available electronically to agency staff. Otherwise, available agency guidance, USEPA guidance, or American Society for Testing and Materials standards should be used.

II.3 Evaluation of Data Qualifiers

Appropriate types of data also include data that have known limitations/uncertainties (data that have been reviewed by the laboratory and a data reviewer and are considered estimated). Analytical data should be qualified by the laboratory and data reviewer when quality control acceptance criteria or other evaluation criteria are not met. All analytical data should have received a thorough review by the laboratory to ensure technical compliance with the specified method. The review for data usability should be performed by the person using standard protocols. As Guidance, the *USEPA Contract Laboratory Program Data National Functional Guidelines for Inorganic Data Review* (USEPA, 1994b) and the *USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review* (USEPA, 1994c) can be used, **where applicable and as discussed in Attachment B**. The sampling data (i.e., field notes, chain-of-custody, sample preservation, etc.) should have been reviewed by the data reviewer. Further, any anomalies in the data should have been noted in the laboratory report using defined flagging criteria to alert the data user to potential problems in the data. The qualifiers assigned by the laboratory and data reviewer should be considered by agency staff when determining which contaminants need to be evaluated further under one of the standards of the existing rule. Imperfect data are almost always usable as long as they are used appropriately and the uncertainty in the data is discussed. In general, agency staff should require consideration of data with qualifiers that indicate uncertainties in concentrations but not in identification (USEPA, 1989a). A more detailed discussion of data qualifiers is provided in Attachment A.

As flagging procedures have not been established by the agency, any flagged data must be accompanied by the definitions for all flags used. The definition for each flag must include a statement on the usability and the uncertainty associated with that flag. Before approving the use of any flagged data, the project coordinator must verify the definition of the assigned flag. When the flags used by the person are clearly defined, the project coordinator can then evaluate the data

appropriately. Flagged data and the implications of that flag on the data should be identified and discussed in the case narrative, and/or the data review summary. If qualifying flags have been added to the reported results, but the person has not clearly defined each flag used, the project coordinator should **NOT** assume the meaning of the flags, but must instead obtain the definition for each flag in writing from the person.

Data flagged as unusable (usually R-flagged) should never be used without prior approval from the executive director. If data have both laboratory qualifiers and qualifiers assigned by the data reviewer, the qualifiers should be evaluated together and the more stringent qualifier should be used (e.g., for data flagged "J" as estimated by the laboratory and "R" as unusable by the data reviewer, the data would be considered unusable) for evaluating the uncertainty in that data. If qualifiers have been attached to certain data by the laboratory and have not been superseded by the data reviewer, then the laboratory qualifier itself should be used to evaluate the uncertainty. Any uncertainty discussion should include a section that describes the level of review performed on the data.

For detected results which have estimated concentrations due to a quality control problem or due to the analytical measurement falling below the laboratory's PQL but above the MDL, the laboratory and/or the data reviewer should flag the data (recommended flag is "J") to indicate to the data user that the chemical is present, but the concentration is estimated. If any of the estimated concentrations drive or contribute significantly to the overall site risk or define significant areas or volumes of environmental media which exceed cleanup levels, the uncertainties associated with such results should be clearly stated in the required reports. This is necessary since the presence of contaminants flagged with a "J" is certain but the concentration of such contaminants is uncertain. Therefore, there is an additional degree of uncertainty when estimated risks and volume calculations for contaminated media are based on data flagged with a "J." The rationale for eliminating data based on the limitations and uncertainties associated with the data should be included in the reports required under the applicable standard of the existing rule (i.e., the baseline risk assessment report for Standard 3 and the final report for Standards 1, 2, and 3).

II.4 Evaluation of Quantitation Limits

Due to the absence of established protocols for reporting data to the TNRCC, non-detected results and results detected near the limit of detection are often reported and evaluated inconsistently and inappropriately. Common errors include: 1) omission of detection and/or quantitation limits; 2) failure to define detection limits that are reported; and 3) unjustified treatment of non-detected results as zero. It is critical that agency staff understand the role of the various quantitation limits (see Attachment B) in calculating the concentration term under all three standards of the existing rule.

II.4.1 Estimated Values Near the Limit of Detection

When the laboratory observes a measurement between the MDL and the PQL as defined in Attachment B, the measurement should be reported at the concentration estimated by the laboratory

and that value flagged with a "J" qualifier to indicate that the contaminant is present, but the concentration is estimated. The person responding to the existing rule should report such estimated results to the agency and such results should be used as reported in calculating the concentration term.

II.4.2 Censoring of Data

According to Chapter 14 of *Statistical Methods for Environmental Pollution Monitoring* (Gilbert, 1987), reporting estimated concentrations of measurements below a detection/quantitation limit is a better approach for calculating the concentration term than "censoring" the data, even though estimated concentrations below these limits will be uncertain. Therefore, it is important to understand the level at which the data have been censored. The term "censoring," as used in this memorandum, refers to the act of eliminating certain observed measurements from the data report. For example, a laboratory's method detection limit for a specific contaminant may be 1 ug/l, while the person requesting the analysis or the laboratory may have established a reporting limit of 5 ug/l for detections. In such cases, when a laboratory analyst observes a measurement above the method detection limit but below the established reporting limit, the analyst will "censor" the datum at the reporting limit and report the contaminant present at concentrations <5 ug/l. Data sets containing this type of information are considered to be "censored on the left." Censoring in this way can eliminate useful data and make it difficult to summarize and compare data sets, as well as lead to biased estimates of means and variances. The preferred approach is to report all verified detected measurements above the MDL, since that is the level at which the identity of the chemical can be confirmed, even though the quantitation at levels below the laboratory's PQL will be uncertain. These estimated concentrations should be used in calculating the concentration term under Standards 1, 2, and 3 of the existing rule.

Results reported as "not detected" (ND) or "below the detection limit" (BDL) are also considered censored data. The contaminant can not be eliminated from further consideration until these nominal terms are quantitatively and qualitatively defined. This is critical, since the value at which these data are censored may be above the level of concern specified under the applicable standard of the existing rule.

All censored data are considered non-detected at a concentration equal to the nominal value at which the data were censored. However, because of sample matrix interferences, the fact that a contaminant is reported as non-detected in a particular sample does not necessarily indicate that it is not present. For this reason, it is important that non-detected sample results be censored at a numerical value that represents the quantitation limit that was achievable by the laboratory when analyzing that sample. This nominal value is called the SQL and is considered most useful in calculating the concentration term, because it accounts for the sample-specific characteristics (e.g., matrix, moisture content, etc.) and sample preparation and/or analytical adjustments (e.g., dilution, sample size, etc.) that were made during analysis of the samples (USEPA, 1992a). It is important to note, that for non-detected results reported as less than the numerical value of the SQL, the contaminant may be present at a level just below the SQL or may not be present at all. Also, as a result of sample-specific problems (e.g., matrix interference, etc.), the SQL for a particular sample may be unusually high, sometimes exceeding positive results reported for the same contaminant in other samples.

II.4.3 Treatment of Non-Detected Analytical Results

As described in *RAGS* (USEPA, 1989a), non-detected results should be considered along with the detected results in calculating the concentration term. In accordance with guidance provided in *RAGS* (USEPA, 1989A), a concentration equal to ½ the SQL or the SQL itself should be assigned as a proxy value for non-detected contaminants when the contaminant is detected in some samples but not in others for the purpose of calculating the concentration term. In cases where there is reason to believe, based on the available analytical information, that the contaminant is present at levels below the SQL, then ½ the SQL should be assigned as the proxy concentration. If, however, there is reason to believe that the actual concentration is close to the SQL, then the SQL value itself should be used as the proxy concentration. For example, if the non-detected results are reported as less than the SQL for a contaminant in a sample that is temporally/spatially related to samples containing detected results above the SQL, a value equal to the SQL rather than ½ the SQL should be assigned as a proxy concentration for the non-detected results. This is necessary since, based upon the results and the sample location, it is reasonable to assume that the concentration for that contaminant may be close to the SQL for that sample. Any contaminant that was reported as non-detected in all samples of a particular medium may be eliminated from further consideration under the existing rule provided that the SQLs for all such samples did not exceed the applicable health-based concentrations of concern as defined in Section II.2. As discussed in Section II.4.2 above, the SQL is considered to be most useful in calculating risk because it accounts for the sample-specific characteristics, sample preparations, and/or analytical adjustments that were made during analysis of the samples.

It is important to note that assignment of the SQL or ½ the SQL as proxy values for non-detected contaminants is considered an acceptable procedure when the data set for a particular contaminant is not predominated by non-detected results and the exposure area can be definitively identified based on documented and verifiable site-specific information. However, when a relatively large number of non-detected results are reported and the exposure area can not be definitively identified based on documented and verifiable site-specific information, it may be inappropriate to simply use the SQL or ½ the SQL as a proxy for non-detects in conducting a statistical test (e.g., 95% UCL on the mean). For these types of data sets, including the non-detected results in the statistical test is likely to dilute out higher concentrations and may artificially reduce the variability in the data set. For example, this reduced variability may translate into an artificially low 95% UCL, especially when a lognormal distribution is assumed. A frequently used "rule of thumb" has historically been to allow use of the SQL or ½ the SQL as a proxy value for non-detected results only when the number of non-detects for a particular contaminant in a medium is less than 50% (USEPA, 1994a). However, more recent guidance from the USEPA (USEPA, 1996a) indicates that it may be inappropriate to use the SQL or ½ the SQL as a proxy value in calculating the concentration term in cases where the data set contains greater than 15% non-detects. In accordance with this recent USEPA guidance, when greater than 15% non-detects are reported and the exposure area can not be definitively identified based on documented and verifiable site-specific information, the executive director may require persons to evaluate alternative statistical methods for calculation of the concentration term. Methodologies considered acceptable for such purposes are outlined in the USEPA document entitled “Guidance for Data Quality Assessment” (USEPA, 1996a).

Observations below the MDL are considered not detected; therefore, these values should be censored and reported as less than the value of the MDL. The relationship between the reported MDL and the applicable health-based concentration of concern as defined in Section II.2 should be used to determine the proxy value assigned to such non-detected results in calculating the concentration term. If the MDL is less than or equal to 20% of the health-based concentration of concern as defined in Section II.2, a proxy value of zero should be used in calculating the concentration term. If, however, the MDL exceeds the health-based concentration of concern as defined in Section II.2, a value equal to the MDL should be assigned as the proxy value in calculating the concentration term. If the MDL is between the health-based concentration of concern as defined in Section II.2 and 20% of that value (i.e., 20% of the health-based concentration of concern), ½ the MDL should be assigned as the proxy value in calculating the concentration term.

When non-detected results are censored at limits other than the SQL or detected results are censored at limits other than the MDL (e.g., contract required detection limit), AND it is not possible or practical to obtain SQLs, the value at which the data were censored should be used as the proxy concentration in calculating the concentration term. Whenever such values are used in calculating the concentration term, however, it is critical that the uncertainties are carefully characterized and the limitations associated with using such values are clearly understood. For example, because a detection limit implies measure at, or below, the limit of detection and does not take into account sample characteristics or matrix interferences (i.e., it is likely to be lower than the SQL), use of a detection limit as a proxy value for non-detected contaminants would result in lower estimated risks than those that would have been estimated if the SQL were reported instead.

III. DATA SCREENING PROCEDURES

As stated in §335.551 (b) of the existing rule, the focus of the rule is on assuring "adequate protection of human health and the environment from potential exposure to **contaminants associated with releases from solid waste management facilities or other areas**" [emphasis added]. As such, efforts should be made to distinguish between contaminants which are reasonably anticipated to be associated with site activities and those contaminants which are not. This distinction is necessary to identify those contaminants detected in site samples for which media cleanup levels must be established under Standards 1, 2, and 3 of the existing rule, as well as to identify those contaminants that must be included in the baseline risk assessment required under Standard 3. When making such a determination, a contaminant should be considered "detected" if it is present at concentrations above the MDL as defined in Attachment B. If an MDL as defined in Attachment B is not provided in the data package submitted to the agency, and such additional information cannot be obtained, then the contaminant should be considered detected for the purpose of the data screening procedures outlined below. Further, in determining the maximum concentration to be employed in the data screening procedures described in this section, detected results should be considered along with non-detected results for a particular medium and the appropriate proxy values should be assigned for the contaminants reported as non-detected as outlined in Section II.4.3. In so doing, the maximum concentration used in the data screening procedures outlined below should be the higher of the maximum detected concentration or the appropriate proxy values (e.g., SQL) for contaminants reported as non-detected in a specific sample.

As already discussed in Section II.4.3, any contaminant reported as non-detected in all samples of a particular medium may be eliminated from further consideration under the existing rule provided that the SQL for the contaminant in all such samples does not exceed the applicable health-based concentrations of concern as defined in Section II.2. Additionally, for the purpose of data screening, contaminants which have been detected within environmental media at a site but which meet ANY of the following four criteria may be considered non-site-related and may be excluded from further consideration under all three standards of the existing rule. This means that media cleanup levels do not need to be calculated for those contaminants, nor is it necessary to include such contaminants in the baseline risk assessment when proceeding under Standard 3. Media cleanup levels must be calculated, however, for all contaminants that do not meet any of the following criteria, and all such contaminants must be evaluated in the baseline risk assessment when proceeding under Standard 3.

1. The contaminant is detected in less than 5% of the samples (a minimum of 20 samples is required) for a particular medium; it is not detected in any other sampled medium; its maximum concentration (the higher of the maximum detected concentration or the appropriate proxy value (e.g., SQL) as described in Section II.4.3 for contaminants reported as non-detected in a specific sample) does not exceed the applicable health-based concentrations of concern as defined in Section II.2; **AND** there is no reason to believe that it is associated with current or historical site activities.

2. The contaminant is a common laboratory contaminant (i.e., methylene chloride, acetone, toluene, 2-butanone (methyl ethyl ketone), phthalates (dimethyl phthalate, diethyl phthalate, di-n-butyl phthalate, butylbenzyl phthalate, bis(2-ethylhexyl)phthalate, di-n-octyl phthalate)); concentrations of the contaminant in **ALL** samples for a particular medium (including consideration of appropriate proxy values as described in Section II.4.3 in cases where a contaminant is reported as non-detected in a specific sample) are less than 10 times the maximum amount detected in any associated blank; the contaminant is not a transformation product of contaminants present at the site; **AND** there is no reason to believe that it is associated with current or historical site activities.

3. The contaminant is not considered by the USEPA to be a common laboratory contaminant as defined above and the concentrations detected in **ALL** samples for a particular medium (including consideration of appropriate proxy values as described in Section II.4.3 in cases where a contaminant is reported as non-detected in a specific sample) are less than five times the maximum amount detected in any associated blank; the contaminant is not a transformation product of contaminants present at the site; **AND** there is no reason to believe that it is associated with current or historical site activities.

4. The contaminant is a TIC; the contaminant is not a transformation product of contaminants present at the site; **AND** there is no reason to believe that it is associated with current or historical site activities.

For certain sites, the list of potentially site-related contaminants remaining after frequency of detection, blank contamination, and TICs have been considered may still be quite lengthy. Carrying all potentially site-related contaminants through the baseline risk assessment required under Standard 3 of the existing rule may not be practical or warranted since it is generally the case that only a few contaminants contribute significantly to the overall risk estimated for a site. Therefore, to facilitate focusing efforts on those contaminants likely to significantly impact overall site risk, the following additional data screening procedure may be used to further identify contaminants which do not need to be included in the baseline risk assessment required under **Standard 3**.

5. The maximum concentration of the contaminant in soils or groundwater (with the maximum concentration being the higher of the maximum detected concentration or the appropriate proxy value (e.g., SQL) as described in Section II.4.3 for contaminants reported as non-detected in a specific sample) does not exceed the applicable risk-based screening value provided for that environmental media on the table entitled "Risk-Based Screening Values" located on TNRCC's web site on the internet at: **www.tnrcc.state.tx.us/waste (hereafter referred to as the risk-based screening values)**.

Persons should provide the agency with a list of **ALL** contaminants eliminated from further consideration. The person should document the basis for elimination, and this should be included in all reports required for the applicable standard of the existing rule. A more detailed discussion of the rationale for, and the limitations of, these data screening procedures is presented in the sections that follow.

III.1 Frequency of Detection

Contaminants that are detected infrequently may be artifacts due to sampling, analytical, or other problems. Although *RAGS* states that it may be valid to eliminate contaminants with a low frequency of detection, it also stresses that contaminants detected at high concentrations should not be eliminated (USEPA, 1989a). Thus, a contaminant that is never detected or detected only infrequently (i.e., the contaminant is detected in less than 5% of the samples) may legitimately be eliminated from further consideration if: 1) it was detected in only a single media; 2) its maximum site concentration (the higher of the maximum detected concentration or the appropriate proxy value (e.g., SQL) as described in Section II.4.3 for contaminants reported as non-detected in a specific sample) does not exceed the applicable health-based concentrations of concern as defined in Section II.2; **AND** 3) there is no reason to believe it is present at the site (based on historical information). It should be noted that at least 20 samples of a particular medium would be required (i.e., one detect would equal 5%) before the frequency of detection rule should be used in eliminating contaminants from a medium (USEPA, 1989a).

III. 2 Blank Contamination

Blank samples provide a measure of contamination that has been introduced into the sample either in the field or in the laboratory. Concentrations of contaminants in associated blank samples should be evaluated to prevent the inclusion of contaminants not related to the site in the risk assessment.

Blank sample data should be compared to results from samples with which they are associated and with the results from the entire data set. Sample dilutions and manipulations should be taken into account when comparing blank data to sample data.

If a contaminant is a common laboratory contaminant as defined in Section III (#2); its concentration in **ALL** samples for a particular medium (including consideration of appropriate proxy values as described in Section II.4.3. in cases where a contaminant is reported as non-detected in a specific sample) is less than 10 times the maximum amount detected in any associated blank; it is not a transformation product of contaminants present at the site; **AND** there is no reason to believe that it is associated with current or historical site activities, then the contaminant can be eliminated from further consideration. If, however, the contaminant is a common laboratory contaminant, as defined in Section III (#2), but is present in **a single sample** (including consideration of appropriate proxy values as described in Section II.4.3 in cases where a contaminant is reported as non-detected in a specific sample) at a level greater than 10 times the maximum amount detected in any associated blank; then the contaminant must be considered to be a site-related contaminant and must be retained for further evaluation.

If the contaminant is not considered by the USEPA to be a common laboratory contaminant as defined in Section III (#2) and the concentrations detected in **ALL** samples for a particular medium (including consideration of appropriate proxy values in cases where a contaminant is reported as non-detected in a specific sample) are less than five times the maximum amount detected in any associated blank; the contaminant is not a transformation product of contaminants present at the site; **AND** there is no reason to believe that it is associated with current or historical site activities, then the contaminant can be eliminated from further consideration. If, however, the contaminant is not a common laboratory contaminant as defined in Section III (#2) and is present in **a single sample** at a level greater than five times the maximum amount detected in any associated blank (including consideration of appropriate proxy values in cases where a contaminant is reported as non-detected in a specific sample), then the contaminant must be considered to be site-related and must be retained for further evaluation.

III. 3 Tentatively Identified Compounds (TICs)

If the TIC is not a transformation product of contaminants present at the site **AND** is not associated with historical operations at the site, then the TIC may be eliminated from further consideration. If, however, a TIC does not meet these criteria, it must be added to the list of contaminants to be evaluated under Standard 1, 2, or 3 unless the person responding to the rule conducts confirmation analyses and is able to document that the identity assigned during the computerized library search was incorrect. It should be noted that the executive director may require confirmation analyses in cases where there is limited information concerning historical or current site activities. In such cases, and when using gas chromatography/mass spectral methods, the laboratory should use the criteria outlined by the USEPA in the document entitled *USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review* (USEPA, 1994c). These criteria are also included in Attachment A of this memorandum.

TICs are all observed measurements in the sample for which the gas chromatograph-mass spectrometer (GC/MS) was not specifically calibrated. GC/MS analyses categorize organic contaminants in two ways. The target compounds are those contaminants for which the GC/MS instrument has been specifically calibrated using authentic standards. Target compounds in environmental samples are identified by matching their mass spectra and relative retention times to those obtained for the standard during calibration. Quantitation of target compounds is based on the instrument's relative response factor between the target compound standard and the target compound in the sample. The tentative identification of a compound is made by comparing its mass spectrum from the environmental sample to a computerized library of mass spectra. The library spectra are scored for their similarity to the mass spectrum of the TIC and the tentative identification is made based on the most similar spectra. Therefore, the identity of a TIC is uncertain. Quantifying TICs is also less accurate than for target compounds because the true relative response factor is not known since the instrument was not calibrated for the TIC. Because of this uncertainty, caution should be exercised prior to considering TICs to be site-related contaminants under any of the three standards of the existing rule. Only those TICs that are possible degradation products of contaminants associated with site activities or are potentially associated with site activities should be evaluated further under the existing rule.

III.4 Risk-Based Screening

Risk-based screening techniques may be appropriate for use in narrowing the list of contaminants to be quantitatively evaluated in the baseline risk assessment required under Standard 3 of the existing rule when the list of contaminants remaining following consideration of the frequency of detection, blank contamination, and TICs is still quite lengthy. In order for a contaminant to be further eliminated from inclusion in the baseline risk assessment, the maximum concentration detected in any sample of soil or groundwater (with the maximum concentration being the higher of the maximum detected concentration or the appropriate proxy value (e.g., SQL) as described in Section II.4.3 for contaminants reported as non-detected in a specific sample) should not exceed the risk-based screening value for the applicable medium as defined in Section III (#5).

The maximum concentration (with the maximum concentration being the higher of the maximum detected concentration or the appropriate proxy value (e.g., SQL) as described in Section II.4.3 for contaminants reported as non-detected in a specific sample) should be used as the comparison value instead of the 95% UCL of the mean during this phase of the data screening process to ensure that only those contaminants that are not likely to significantly contribute to overall risk are excluded. Further, since groundwater protection is not addressed by the risk-based screening concentrations used in this data screening step, cross-media transfers to groundwater must be considered prior to eliminating a contaminant in soil from consideration. Therefore, any contaminant remaining after consideration of frequency of detection, blank contamination, and TICs should be evaluated for its potential to migrate to groundwater in accordance with the procedures outlined in the existing rule.

Finally, use of the concentration toxicity screen recommended in *RAGS* (USEPA, 1989a) should **NOT** be allowed because it can eliminate contaminants which could contribute significantly to the overall site risk (USEPA, 1995).

IV. CALCULATING THE CONCENTRATION TERM

IV. 1 General Statistical Considerations

IV.1.1 Random vs. Purposeful (Judgmental) Sampling Designs

When using sampling data to make inferences about the true average contaminant concentration at a site (e.g., calculating a 95% upper confidence limit (UCL) on the mean), the underlying assumptions of the statistical test must be considered. In general, random/stratified sampling designs are required for statistical inferences about the mean contaminant concentration, as they minimize selection bias in sampling. TNRCC recognizes that for many sites, however, samples collected for use under the existing rule will not have been collected in a random fashion. Instead, for the majority of sites, samples will have often been collected in the area of suspected maximum contaminant concentration within an exposure area and also at locations within exposure media that are expected to be beyond the extent of contaminant migration. This type of judgmental sampling typically results in an unquantifiable over- or underestimation of the true site average, depending on the sampling strategy.

The default assumption when reviewing judgmental sampling data should be that the data are incompatible with most inferential statistical applications (e.g., calculating a 95% UCL on the mean). However, if it can be adequately demonstrated that the judgmental data are representative or biased towards higher site concentrations (i.e., data are likely to provide a conservative estimate of a true mean), it may be reasonable to allow statistical consideration of the sampling data. Alternatively, non-parametric statistical methods or other statistical approaches which are valid for the distribution of the data may be used subject to the prior approval of the executive director.

IV.1.2 Calculation of a 95% UCL on the Mean

When calculating a 95% UCL on the mean for data sets characterized by extreme variability in measured concentrations, the 95% UCL can exceed the highest measured or modeled concentration. In these cases, if additional data cannot practicably be obtained, the highest measured or modeled value should be used as the concentration term (refer to Section II.4.3 for procedures on handling non-detected analytical results). In cases where a lognormal distribution has been assumed and a significant number of non-detected results are included in the data set, it is possible for the 95% UCL on the mean to be below the sample arithmetic mean. If this occurs, the data set should be re-evaluated to determine if the distributional assumptions for the data were valid, and to assess whether non-detected results were treated appropriately for purposes of performing the calculations.

IV.2 Evaluation of Groundwater Data

IV.2.1 Estimating Representative Concentrations

Estimating concentrations in groundwater using models can be a complex task because of the many physical and chemical processes that may affect transport and transformation in groundwater. The extent to which the hydrogeologic properties of the aquifer are characterized may significantly impact the estimation of risk from groundwater. Therefore, groundwater samples should be collected in such

a way that the contaminant plume, with respect to potential exposure points, is adequately defined. When using groundwater data for risk assessment purposes, it is critical that the estimated concentrations reflect the reasonable maximum concentrations of contaminants in the aquifer of concern. Therefore, statistical methods should not be used to determine representative contaminant concentrations across groundwater wells (inter-well) except when determining representative source groundwater concentrations for the groundwater-to-air pathway.

The ideal placement of wells for determining reasonable maximum concentrations is near the apparent center of the plume (USEPA, 1991). While the center of the plume may not be readily identifiable, a reasonable approximation would be the monitoring well containing the maximum detected concentrations. When time series data are available, a trend analysis should be performed to determine directional trends and determine the data set that is most appropriate for use in the risk assessment. If concentrations are stable or decreasing, the most recent data set (e.g., data collected over the last two years) should be used. Otherwise, the maximum detected concentration over all sampling events should be used. Since the maximum detected concentration for individual contaminants may occur within different wells, the maximum detected concentration amongst all of the sampled wells for each individual contaminant of concern should be used as the concentration term.

While statistical methods may not be used to estimate representative concentrations across wells (with the exception of the groundwater-to-air pathway), they may be used to determine representative concentrations within an individual well (intra-well). The uncertainty associated with estimating true average concentrations necessitates the calculation of a 95% UCL on the mean. The variance estimators that are often used in risk assessment require that the data are independent or uncorrelated. Certain types of repeated samples, such as those from groundwater wells, are time-series data that may be correlated. In other words, the concentration measured in a groundwater well on one day will depend, in part, on concentrations detected in the past since they are partially dependent on well-specific characteristics (i.e., well construction, pump rate, etc.). To reduce the dependence caused by seasonal variability, intra-well sampling should be separated in time. Otherwise, if time series data that are correlated are assumed to be random and are used to calculate a 95% UCL, the confidence limits can be underestimated (USEPA, 1989a). Data collected over at least four quarters from an individual well should be required for calculating a 95% UCL. In this circumstance, it is not necessary to require a minimum of 10 samples for calculating a 95% UCL. Given that it is common to collect a single sample during each quarter over a year, to require 10 samples for each well would extend the sampling out to two and a half years, thereby delaying site decisions and progress. It is undesirable to collect multiple samples within a well during quarterly sampling for use in calculating a 95% UCL because the data points would be correlated and, therefore, inappropriate for use in calculating a 95% UCL. It is important to note that the requirement to collect four quarterly samples over a period of one year or longer only applies when there is a desire to determine a representative concentration within an individual well using statistics (e.g., 95% UCL on the mean). A representative concentration could be determined from a single sampling event from the well with the highest concentration of a particular contaminant.

IV.2.2 Filtering Groundwater Samples

According to *RAGS* (USEPA, 1989a), unfiltered groundwater samples should be used to estimate the concentration term. Groundwater samples need to be representative of groundwater conditions in which the water chemistry of the sample is not altered due to the sample handling, the method of pumping or the materials from which the pump is made. To achieve this goal, the following technical guidance on the proper collection and handling of groundwater samples has been provided since April of 1996 (USEPA, 1996b):

- Sampling methodologies which do not artificially increase or decrease naturally suspended particle concentrations should be used;

- Groundwater samples should be collected using a low flow rate (e.g., 0.1 liter/minute) that does not exceed the rate at which the well was developed and minimizes drawdown (i.e., less than 0.1 meter) in the well;

- Groundwater samples should not be filtered when:

    1. aquifers contain naturally occurring suspended particles resulting from transport through the aquifer due to the nature of the subsurface geology;

    2. samples are collected for organic compounds analysis; or

    3. samples are collected from drinking water wells.

- Use of a 10.0 micron filter (only) to filter groundwater samples should only be approved when turbidity exceeds 10 nephelometric turbidity units and the filtering can be performed while still fulfilling the data quality objectives;

- Samples for metals analysis should be preserved at the time of collection to a pH of less than 2 using nitric acid, with the exception of samples to be analyzed for chromium^{+6}. The preservation for chromium^{+6} is to cool the sample to 4°C.

If groundwater data were not collected using a low flow method, the naturally occurring suspended particle concentrations may have been artificially increased or decreased as a result of the sampling protocol. For groundwater samples that were not collected using a low flow method **AND** that do not meet the criteria for proper collection and handling of groundwater samples outlined above, both filtered and unfiltered groundwater samples should be considered when available so that the distribution of metals in groundwater can be fully characterized. If the results for filtered and unfiltered samples are available and are similar, then unfiltered results should be used in calculating the concentration term for that well. If a notable disparity exists between filtered and unfiltered monitoring well data, then the results from the filtered samples should be used (USEPA, 1992c). Reasonable implementation of this guidance is important given that vast amounts of groundwater data may have been collected using a method other than a low flow method. Where groundwater data has not been collected in accordance with the guidance outlined in Section IV.2.2, it may be reasonable

to direct sampling following these procedures in key locations on the site in order to evaluate the variance.

IV.3 Evaluation of Soil Data

IV.3.1 Exposure Area

The 95% UCL on the mean represents a conservative estimate of the average contaminant concentration encountered by an individual who moves randomly over a given exposure area. The assumption that exposure is equally likely at all locations within the exposure area is implicit to the 95% UCL calculation. Therefore, identification of an appropriate exposure area for both current and likely future exposures is essential for calculating the concentration term. The assumed exposure area should represent the smallest area over which an individual can be expected to move randomly and should be determined based on documented and verifiable site-specific information. If, based on known site and population characteristics, it cannot be argued that contact over the area is spatially random, then averaging exposure concentrations would not be appropriate.

In defining an exposure area, it is also necessary to consider the uniformity of the site concentrations. At many sites, contamination may be unevenly distributed across a site, resulting in locations with substantially higher concentrations of the contaminant of concern than in surrounding areas of the site (i.e., hot spots). In general, the exposure area should be defined in such a way that data variability is reduced as much as possible (e.g., subdividing into smaller homogeneous areas as necessary). While this type of approach may require more sampling, *RAGS* states that subdividing the site may result in improved statistical performance and better risk management decisions, as total variability in contaminant concentrations can be reduced (USEPA, 1989a). Further, in cases where a hot spot is located in an area which, because of site or population characteristics, is visited or used more frequently, exposure to the hot spot should be assessed separately (USEPA, 1989a). Hot spots should be determined qualitatively. As a general rule of thumb, a distinctly apparent area of elevated contaminant concentrations that are associated with risks or hazards for individual contaminants which significantly exceed the acceptable regulatory thresholds of $1x10^{-6}$ for carcinogens and 1.0 for non-carcinogens should be considered a hot spot.

In general, when less than ten soil samples are collected within a given exposure area, inferential statistics (e.g., calculation of a 95% UCL on the mean) should **NOT** be utilized (USEPA, 1992b). In addition to poorly characterizing variability, small sample sizes often result in wide confidence intervals around a sample mean. Sample size is used directly in the calculation of a 95% UCL on the mean, and is also considered when identifying an appropriate Student's t-statistic. Thus, as sample size decreases, the difference between the true mean and the 95% UCL increases.

While current activity patterns are somewhat easier to establish at a site, there are significant uncertainties associated with predicting likely future exposure patterns. Therefore, in an effort to expedite the review and approval process by the agency, and to ensure that cleanups are protective of current and likely future exposures, the TNRCC is adopting default exposure area guidelines for both residential and commercial/industrial sites. Support for these guidelines is provided in the following sections.

IV.3.1.1 Residential Scenarios

Averaging over a larger area of a site than could routinely be contacted by an individual has the potential to underestimate actual exposures. In addition, averaging over extensive areas of a site potentially increases the variance in the data and may result in an elevated 95% UCL on the mean, especially if soil contamination is not uniform. Therefore, in an effort to decrease the uncertainty associated with the concentration term, as well as to minimize the potential for inappropriate characterization of exposure, the exposure area for a residential scenario should be assumed to be equal to a default of 1/8 acre (USEPA, 1989a) or, in the case of an existing affected residential lot, to the size of either the front or back yard not to exceed ½ acre (since residents are unlikely to move randomly over the entire property when residential lots are large). In cases where contamination is present on undeveloped properties with the potential for future residential use, it may be argued that dividing a site into relatively small exposure areas will not accurately depict the area over which exposure is expected to be integrated over the period of time assumed in estimating exposure. Therefore, responsible parties should be allowed to demonstrate that a larger exposure area is appropriate based on documented and verifiable information (e.g., sizes of existing residential lots, zoning requirements) for future residential development. However, given the extreme uncertainty associated with attempting to predict potential future residential activities, if a responsible party utilizes an area larger than 1/8 acre or the size of the front or back yard of an existing affected residential lot (not to exceed ½ acre), the responsible party should be required to note this fact by filing a deed notice within the real property records of the county of the affected property.

IV.3.1.2 Commercial/Industrial Scenarios

As discussed above, averaging over a larger area of a site than could routinely be contacted by an individual has the potential to underestimate actual exposures. In addition, averaging over extensive areas of a site potentially increases the variance in the data and may result in an elevated 95% UCL on the mean, especially if soil contamination is not uniform. Therefore, in an effort to decrease the uncertainty in risk estimations, as well as to minimize the potential for inappropriate characterization of exposure, the exposure area for a commercial/industrial scenario should be assumed to be equal to a default of ½ acre. This position is supported by information from the National Utility Contractors Association, which reports that most industrial site workers typically move over a ½ acre area on a given day (Neptune et al., 1990). However, TNRCC recognizes that at a given site it may be argued that dividing the site into relatively small exposure areas will not accurately depict the area over which exposure is expected to be integrated over the period of time assumed in estimating exposure. Therefore, responsible parties should be allowed to demonstrate that a larger area is appropriate based upon documented and verifiable activity pattern information for workers at an active, operational facility, or based on sufficient analytical data indicating that contamination is homogeneous across a larger assumed exposure area. Detailed documentation of the type of activities that will take place on-site, how often the activities occur, and the areas within the site at which the activities will take place should be provided. After evaluating this information, the exposure area should be defined as the smallest area within which it is believed that exposure could be limited under the <u>most</u> conservative, reasonable current or future use scenario (Michael, 1992). However, given the extreme uncertainty associated with attempting to predict potential future worker activities, if a responsible party utilizes an area larger than ½ acre, the responsible party should be

required to note this fact by filing a deed notice within the real property records of the county of the affected party.

IV.3.2 Soil Depth

IV.3.2.1 Residential Properties

For closure/remediation in accordance with Risk Reduction Standard 2, §335.559(f) requires that persons propose media cleanup levels for contaminants present **throughout the entire soil column (i.e., surface and subsurface soils), based upon residential human exposure and groundwater protection**. However, under Risk Reduction Rule Standard 3, persons are required to calculate media cleanup levels for contaminants present at all points in the soil column where direct contact exposure to soils may occur (§335.5639(i)). For the purpose of evaluating residential direct contact exposure pathways as required under Standard 3, the agency has determined that it is appropriate to limit the applicable soil column to a depth that is reasonably likely to be encountered as a result of excavation activities which could bring contaminated materials to the surface. As such, the agency has defined residential surface soil under Standard 3 as the soil zone extending from ground surface to 15 feet in depth or to the top of the groundwater-bearing unit, whichever is less in depth. In order to achieve consistency in evaluating residential properties, this definition of **surface soils** should also be applied when undergoing closure/remediation under Standard 2. However, given the requirement that soil MSCs based on both human exposure and groundwater protection are to be applied to subsurface soils when evaluating residential properties (§335.559(f)), concentrations of contaminants present below 15 feet (i.e., subsurface soils) must also be addressed for these pathways.

IV.3.2.2 Non-Residential Properties

When addressing non-residential properties, Standard 2 requires that persons set MSCs for contaminants present in near-surface soils (i.e., within two feet of the land surface) (§335.559(g)), considering both human health exposure pathways and groundwater protection. The agency has maintained this specified soil depth for near-surface soils in defining soil depths for evaluating direct contact exposure pathways for non-residential receptors under Standard 3. As such, the agency has defined surface soils for non-residential land uses as all soils extending from ground surface to 2 feet in depth or to the top of the groundwater-bearing unit, whichever is less in depth. §335.559(g) also requires that MSCs be established based on consideration of groundwater protection for all contaminants in non-residential subsurface soils (i.e., the portion of the soil zone between the base of the surface soil and the top of the groundwater unit).

IV.3.2.3 Appropriate Soil Depth for Use in Statistical Evaluations

When applying statistical procedures to calculate the concentration term for soils on residential properties under either Standard 2 or Standard 3, available data should be aggregated into the following two categories: (1) data collected **only** from the vertically contaminated interval within the zone extending from ground surface to a maximum of 2 feet (i.e., if contamination is limited to the

upper 6 inches of soil, then concentrations should not be diluted by averaging with 1 ½ feet of clean soils when calculating the concentration term), and (2) all available data collected from 2 feet to 15 feet below ground surface or to the top of the groundwater-bearing unit, whichever is less in depth. Additionally for Standard 2 only, all available data from 15 feet below ground surface to the top of the groundwater-bearing unit should be aggregated together when calculating the concentration term for that depth interval.

For non-residential properties evaluated under either Standard 2 or Standard 3, persons desiring to use statistical approaches in calculating the concentration term for the human exposure pathway must **only** use data from the vertically contaminated interval within the near-surface soil (i.e., from ground surface to a maximum of two feet in depth). Sample concentrations throughout the entire 2 ft depth interval should not be used in calculating the concentration term unless contamination extends throughout the entire depth interval.

The requirements outlined in this section pertaining to appropriate soil depths for use in statistical evaluations are intended to describe how soils should be evaluated vertically, and do not limit the use of soil data collected over a given exposure area (i.e., in the horizontal dimension).

IV.3.3 Evaluation of the Soil-to-Groundwater Pathway

If a site-specific soil-to-groundwater contaminant fate and transport model is used which requires a soil contaminant source mass or soil source concentration input, then the source area should be assumed to be the vertical and horizontal limits of all soils with concentrations in excess of the Remedy Standard No. 2 GWP MSCs provided in the table entitled "Updated Examples of Standard No. 2, Appendix II Medium-Specific Concentrations" located on TNRCC's web site on the internet at: **www.tnrcc.state.tx.us/waste**. The maximum concentration within the source area or a 95% UCL on the mean concentration within the source area may be used to estimate the soil source mass or concentration term. Once a groundwater-protective soil concentration is determined, then the same method used to derive the source term (i.e., max or 95% UCL) should be used to evaluate exceedance of the groundwater-protective soil concentration for the same volume of soil. It should be noted that this approach is only applicable to forward calculations using predictive modeling.

V. ENGINEERING AND INSTITUTIONAL CONTROLS

Section 335.553(b)(2) of the existing rule states that a baseline risk assessment should be prepared which describes the potential adverse effects under both current and future conditions caused by the release of contaminants *in the absence of any actions to control or mitigate the release*. Therefore, because the risk assessment must reflect site conditions absent any controls, the presence of engineering (e.g., fences, caps, groundwater extraction systems) controls, or institutional (e.g., deed restrictions, personal protective equipment (PPE), etc.) controls should **NOT** be allowed as justification for ruling out exposure scenarios or pathways.

In the special circumstance where the owner or operator has previously filed and received approval from the TNRCC for a response action plan involving an engineering control such as a cap over a

closed landfill, the presence of that engineering control may be taken into account when a subsequent baseline risk assessment is performed for the land area including the previously closed landfill. In order to use this flexibility, the owner or operator must provide the agency with appropriate assurances to guarantee the continued maintenance/enforcement of the existing engineering controls at the site.

If an unacceptable risk or hazard is determined for a site assuming the absence of existing engineering or institutional controls, then such existing engineering or institutional controls may be proposed as a risk management option during remedy selection.

VI. CONSIDERATION OF MAXIMUM CONTAMINANT LEVELS (MCLs), PRACTICAL QUANTITATION LIMITS (PQLs), AND SITE-SPECIFIC BACKGROUND IN THE CUMULATIVE RISK EVALUATION UNDER STANDARD 3

VI.1 Maximum Contaminant Levels (MCLs)

Section 335.563(h) of the existing rule states that media cleanup levels for groundwater that is a current or potential source of drinking water shall not exceed MCLs promulgated under the Safe Drinking Water Act. Thus, the agency does not require that response actions be taken when concentrations in groundwater meet applicable MCLs. As such, the agency has determined that it is unnecessary to calculate individual cancer risk levels or hazard quotients for contaminants with MCLs promulgated under the Safe Drinking Water Act. Instead, such contaminants should be evaluated in the baseline risk assessment based on individual comparisons with applicable MCLs. In addition, the existing rule specifies that although the cleanup level for an individual contaminant may be acceptable from a health standpoint (e.g., no carcinogen is present above a 10^{-6} risk level) cumulative carcinogenic risks and noncancer hazards must be evaluated to ensure that cleanup levels are protective of exposures to multiple contaminants. However, given the following considerations, the agency has also determined that it is not necessary or appropriate to include contaminants present at levels at or below the MCL in this cumulative risk evaluation:

- MCLs are not uniformly set at a specified risk/hazard level, and may also account for factors other than risk (e.g., technical practicability);

- As MCLs represent Federal standards for individual contaminants, any public water system user could potentially consume drinking water containing multiple contaminants each at their respective MCL. The implied assumption here is that individual MCLs are considered to be adequately protective and a cumulative evaluation is not required.

VI.2 Practical Quantitation Limits (PQLs)

According to the requirements for Standard 1 of the existing rule, if the PQL is greater than the background concentration, then the PQL shall be used as the cleanup level provided that the person satisfactorily demonstrates that lower levels of quantitation of the contaminant are not possible.

Likewise, for Standards 2 and 3, if the PQL and/or the background concentration is greater than the risk-based cleanup level, then the greater of the PQL or background shall be used as the cleanup level. The PQL is defined in 30 TAC §335.552 as "the lowest concentration of an analyte which can be readily quantified within specified limits of precision and accuracy during routine laboratory operating conditions." However, because some laboratories began defaulting to the PQL value provided in guidance instead of actually determining the lowest concentration, the USEPA has modified the term PQL to become the Method Quantitation Limit (MQL). The USEPA defines MQL as "the lowest concentration calibration standard that is analyzed during an initial calibration" (Method 8000B, Section 7.4, SW-846, 1996). The USEPA states in Method 8000B, Section 7.4, SW-846, 1996 that "For each analyte, at least one of the calibration standards should correspond to a sample concentration at or below that necessary to meet the data quality objectives of the project, which may include establishing compliance with a regulatory action or limit." Therefore, persons should consider the PQL to be the lowest non-zero calibration standard for the most sensitive **standard available method** (as discussed in Section II.2) in order to meet the intent of the authors of the existing rule.

In cases where the following three conditions are met, a specific contaminant in a particular medium may be excluded in the evaluation of cumulative risk or hazard.

1. The PQL is established as the cleanup level for a specific contaminant in accordance with the provisions outlined pertaining to media cleanup requirements for Risk Reduction Standard Number 3 (§335.563(j));

2. The project coordinator has confirmed that the PQL is in fact the lowest non-zero standard in the calibration curve for the most sensitive **standard available method**; AND

3. The concentration of the contaminant in **ALL** samples of a particular medium is less than or equal to that PQL.

It is critical to note that in cases where the PQL is established as the cleanup level for a particular contaminant, the selected remedy must be able to remove, decontaminate, and/or control wastes and contaminated media to the PQL.

VI.3 Background Determination

As already mentioned in Section VI.2 of this memorandum, the existing rule allows for consideration of site-specific background levels of a contaminant when determining an appropriate media cleanup level under Standard 3. In establishing site-specific background concentrations as a default cleanup level under all three standards of the existing rule, the TNRCC has implied that such levels are not a concern and need not be remediated further. This is consistent with evidence indicating that risks posed by background site concentrations are typically low relative to risks posed by site contaminants (USEPA, 1989a). As such, the TNRCC has determined that it is unnecessary to include contaminants

present at concentrations below **site-specific** background concentrations in the evaluation of cumulative risk or hazard.

The establishment of a site-specific background concentration should be based on samples taken from an area of the site that has not been impacted by site activities, or from an unimpacted area near the site so that they will have the same basic characteristics as the medium of concern (e.g., pH of soil/water, organic carbon content of soil, redox potential of water, etc.) at the site (USEPA, 1989a). Information on background concentrations obtained from Soil Conservation Surveys or U.S. Geological Survey reports **should not** be used to characterize site-specific background. For groundwater, monitoring wells located to determine background concentrations of contaminants should be upgradient of the affected property, within the same groundwater zone, and along the same flow path. Detailed descriptions of the methodology used in performing the background comparison for either soil or groundwater should be requested by the project coordinator.

Although background is most commonly considered for naturally-occurring metals, it may also be appropriate to consider anthropogenic background concentrations for other contaminants. Anthropogenic background concentrations are those concentrations present in the environment due to the activities of human beings that are not the result of unauthorized use or releases of waste or products, or of industrial activities. Examples of contaminants for which it may be appropriate to establish anthropogenic background concentrations include lead, arsenic, and polyaromatic hydrocarbons (PAHs). Potential non-specific sources for these contaminants include automobile emissions for lead, wide-spread agricultural use of arsenic in defoliants, and forest fires or fossil fuel combustion for PAHs. There are some commonalities to contaminants for which it may be appropriate to establish anthropogenic background concentrations, regardless of the source or activity that resulted in the contamination. Specifically, the contaminants are present over large areas (tens of square miles up to hundreds of square miles) and the concentration levels are generally low.

VII. EVALUATION OF THE DERMAL EXPOSURE PATHWAY

For soil exposures, the existing rule requires that, at a minimum, soil ingestion and inhalation of volatiles and particulates be combined. However, as specified in §335.556(b), the rule also requires evaluation of other exposure pathways (e.g., dermal exposure) by which human populations are likely to be exposed. As such, the dermal pathway should be evaluated under both Standards 2 and 3. While the soil MSC equation for ingestion and inhalation of volatiles and particulates is provided in the rule, specific equations and input parameters are not specified for the dermal exposure pathway. This has created some confusion in evaluating dermal exposures. For convenience, the essential information for evaluating the dermal exposure pathway is provided in the sections which follow.

VII.1 Toxicity Values for Dermal Exposure

Quantitative toxicity estimates for dermal exposure have not been developed by the USEPA. Therefore, oral reference doses (RfDs) and oral cancer slope factors (CSFs) are typically used to determine toxicity factors for dermal exposures. Since oral toxicity values are typically based on administered dose, while the methodologies recommended for evaluating dermal absorption (USEPA, 1992e) give rise to an estimation of absorbed dose, it may be necessary to adjust oral toxicity values

to account for this discrepancy. Adjustment of an oral reference dose/slope factor should be performed when the following conditions are met:

1. The oral toxicity value was derived based on an administered dose, for example, via diet or gavage (note: if the oral toxicity value is already expressed as an absorbed dose, it is not necessary to adjust it further in estimating a dermal toxicity value); and

2. A scientifically defensible study demonstrates that the gastrointestinal (GI) absorption (ABS.gi) is significantly less than 100%. As a result of the intrinsic variability in the analysis of absorption studies, the agency has defined a GI absorption of less than 50% as "significantly different from 100%." Thus, oral toxicity values should only be adjusted in cases where a scientifically defensible study indicates that the GI absorption is 50% or less. Establishment of 50% as the cutoff value obviates the need to make comparatively small adjustments to the toxicity values that would otherwise impart a level of accuracy that is not existent.

Ideally, ABS.gi values should be obtained from studies employing an exposure medium (e.g., water, feed, corn oil) similar to that used in the critical study which served as the basis for the oral toxicity value. As this would necessitate an exhaustive search of the literature, the agency considers the approach developed by Bast and Borges (1998) to be an acceptable procedure for identifying ABS.gi values. Although the approach developed by Bast and Borges (1998) for determining GI absorption values introduces uncertainties, it utilizes moderate assumptions. The alternative in assessing risk/hazard associated with dermal exposure is to employ extreme assumptions, such as the non-conservative approach of always assuming that a contaminant is completely absorbed (i.e., 100% absorption) from the GI tract (i.e., oral toxicity values are not adjusted) or the relatively conservative approach of always assuming that a contaminant is poorly absorbed (e.g., less than 5%) by the GI tract (i.e., oral toxicity values are adjusted using a default ABS.gi value of 5%).

In cases where GI absorption data are not available from the Bast and Borges database, nor available from the scientific literature, the agency recommends using the following default GI absorption values: 80% for volatile organics, 50% for semi-volatile and nonvolatile organics, and 20% for inorganics (note, when using these default values, oral toxicity values would only need to be adjusted for semi-volatile and non-volatile organics and for inorganics since the default value for volatiles exceeds the cutoff value of 50%). For convenience, the recommended GI absorption values are provided in Attachment C.

RAGS (USEPA, 1989a) provides a method for adjusting oral RfDs and oral CSFs which have been derived based on administered doses to RfDs and CSFs that are appropriate for use with estimates of absorbed doses. In accordance with this method, the following equations should be used to adjust oral toxicity values for carcinogens and non-carcinogens, respectively.

$$\textit{For carcinogens}: \quad SF_d = \frac{SF_o}{ABS_{GI}}$$

where:

SF_d = Dermal slope factor (i.e., internal dose cancer slope factor) $(mg/kg\text{-}day)^{-1}$
SF_o = Oral cancer slope factor $(mg/kg\text{-}day)^{-1}$

$$For\ noncarcinogens: \quad RfD_d = RfD_o \times ABS_{GI}$$

RfD_d = Dermal reference dose (i.e., internal reference dose) (mg/kg-day)
RfD_o = Oral reference dose (mg/kg-day)
ABS_{GI} = GI absorption fraction (unitless)

VII.2 Dermal Relative Absorption Fraction

The dermal relative absorption fraction (ABS.d) is the fraction of the contaminant applied to the skin that is absorbed. The availability of empirical data for dermal absorption of contaminants from soil is limited. The agency has identified those contaminants for which it believes there are sufficient data to derive ABS.d values for soil. For all contaminants which do not have specific ABS.d values from soil, the following default dermal absorption values recommended by USEPA Regions 6 and 9 should be used until such time that contaminant-specific information becomes available: 0% for volatile organic compounds, 10% for semivolatile and nonvolatile organic compounds, and 1% for inorganic compounds. A cursory comparison of the recommended default values to the contaminant-specific values available indicates that the default values generally fall in the mid-range of the experimental values for each contaminant/class of contaminants for which empirical data are available. Therefore, the TNRCC considers the recommended defaults to be an acceptable interim measure.

In accordance with recommendations of the USEPA, organic contaminants with a vapor pressure between 1 and $1x10^{-7}$ mm Mercury should be considered semivolatile, while those with a vapor pressure less than $1x10^{-7}$ should be considered nonvolatile (USEPA, 1992f). For convenience, the recommended dermal absorption (ABS.d) values are provided in Attachment C.

VII.3 Procedure for Calculating Cleanup Levels Protective of Dermal Contact with Soil

The *Dermal Exposure Assessment Document* (USEPA, 1992e) is recommended for guidance on procedures and equations that should be used to evaluate dermal exposure. For convenience, the equations and default exposure parameters for calculating risks and hazards resulting from dermal contact with soil for residential, commercial/industrial worker, and trespasser scenarios are provided in Attachment D.

VIII. TARGET CANCER RISK LEVELS AND HAZARD QUOTIENT/INDEX

VIII.1 Evaluation of a Single Contaminant in a Medium in Accordance with the Requirements Specified for Standard 3

For carcinogens, a cancer risk level of one in one million ($1x10^{-6}$) shall be used to establish media cleanup levels for each individual contaminant. For noncarcinogens (systemic toxicants), the hazard quotient should not exceed one (1) for any individual contaminant.

The existing rule establishes the target cancer risk level and hazard quotient that must be achieved. With respect to carcinogens, §335.563(b) states that "For known or suspected carcinogens, media cleanup levels shall be established at concentrations which represent an excess upperbound lifetime risk of between one in 10,000 and one in one million. The executive director will use one in one million as a goal in establishing such limits." The preamble to the rule further clarifies the commission's intent on this issue by stating that "one starts with the goal of 10^{-6} for an individual carcinogen but then modifies this "preliminary remediation goal" according to the criteria of subsection (d) of this section." The specific criteria outlined in §335.563(d) which would allow the executive director to consider a higher (i.e., less conservative) risk goal is limited to technical feasibility issues such as the technical limitations, effectiveness, practicability, or other relevant features of available remedies. Cost is not a factor when determining the level of protection to be provided to human health and the environment. The rule further states that when the background concentration of an individual contaminant is greater than the risk-based level, then the background value shall serve as the cleanup level. Thus, for carcinogens, the cleanup level for an individual contaminant should initially be established at $1x10^{-6}$ and can only be raised based on consideration of technical feasibility and background concentrations.

VIII.2 Evaluation of Multiple Contaminants in a Medium in Accordance with the Requirements Specified for Standard 3

As specified in §335.563 of the existing rule, for carcinogens, a cumulative cancer risk level of one in ten thousand ($1x10^{-4}$) shall be used to establish media cleanup levels that are protective of exposures to multiple carcinogenic contaminants. For noncarcinogens (systemic toxicants), a hazard index of one (1) shall be used to establish media cleanup levels that are protective of exposures to multiple noncarcinogenic contaminants. A contaminants which exhibits both carcinogenic and noncarcinogenic characteristics should be evaluated as both a carcinogen and noncarcinogen.

It should be emphasized that all media cleanup levels must achieve the target risk and hazard levels for **individual** contaminants specified above in Section VIII.1 of this memorandum. Evaluation of cumulative risk and hazard is **only** for the purpose of determining whether the media cleanup levels established in accordance with the risk level and hazard quotient specified in Section VIII.1 for an individual contaminant need to be adjusted downward to account for exposures to multiple contaminants in a media. It should be noted that for carcinogens, a site would have to have greater than 100 contaminants each present at a concentration equivalent to a $1x10^{-6}$ risk level before any downward adjustment of the cleanup levels established for each of the individual contaminants would be necessary. The following equations are provided as tools for determining whether cleanup levels must be downwardly adjusted for individual contaminants:

$$100 \geq \frac{CL\text{-}adj_1}{CL_1} + \frac{CL\text{-}adj_2}{CL_2} + \ldots + \frac{CL\text{-}adj_i}{CL_i} \qquad (CARCINOGENS)$$

$$1 \geq \frac{CL\text{-}adj_1}{CL_1} + \frac{CL\text{-}adj_2}{CL_2} + \ldots + \frac{CL\text{-}adj_i}{CL_i} \qquad (NONCARCINOGENS)$$

where:

$CL\text{-}adj_i$ = Cleanup Level in the relevant medium for contaminant "i" adjusted for cumulative effects associated with multiple contaminants (mg/kg or mg/l)

Cl_i = Cleanup Level for individual contaminant "i" (mg/kg or mg/l) based upon a cancer risk level of $1x10^{-6}$ or hazard quotient of 1

IX. CALCULATING A SOIL MSC VALUE UNDER RISK REDUCTION STANDARD NUMBER 2

For calculation of a soil MSC under Risk Reduction Standard Number 2, the following equation incorporating soil ingestion, inhalation of volatiles and particulates from soil, and dermal contact with soil should be used:

$$SoilMSC = \frac{1}{\frac{1}{MSC_{Inhalation\ +\ Ingestion}} + \frac{1}{MSC_{Dermal}}}$$

Where:

$MSC_{Inhalation + Ingestion}$ = Medium-Specific Concentration in soil as per Equations 2, 4, 5 or 6 in §335.567. Appendix (includes inhalation and ingestion pathways); also provided in Attachment D of this memorandum;

MSC_{Dermal} = Medium-Specific Concentration in soil for the dermal pathway as calculated per Attachment D of this memorandum.

For convenience, all soil MSC equations and default parameters for residential and commercial/industrial scenarios (inhalation, ingestion, and dermal pathways) are provided in Attachment D. Section 335.558(d) of the existing rule indicates that the commission will periodically revise the example Standard 2 MSCs presented in the Appendix II table to reflect newly promulgated standards and to provide MSCs based on current toxicological data. Additionally, §335.556(b)

requires that other relevant exposure pathways, such as dermal absorption, be evaluated when setting MSCs. However, because no specific equations and parameters were provided in the rule, and no guidance has been provided as to how the dermal absorption pathway is to be evaluated in relation to the soil ingestion and inhalation pathways, consideration of the dermal absorption pathway has not been addressed in a consistent manner. Therefore, in order to facilitate implementation of Standard 2, the MSC values have been updated to reflect current standards, toxicological factors, and the soil dermal absorption exposure pathway. For convenience, the updated Standard 2 MSCs, along with the most current toxicity factors, are provided in the tables entitled "Updated Examples of Standard No. 2 Medium-Specific Concentrations" and "Toxicity Factors" on the Office of Waste Management home page on the internet **(http//:www.tnrcc.state.tx.us/waste)**. In addition, updated chemical/physical properties are provided in Attachment E of this memorandum.

X. CALCULATING A SOIL MSC VALUE UNDER RISK REDUCTION STANDARD NUMBER 3

For calculation of a soil MSC under Risk Reduction Standard Number 3, the following equation incorporating soil ingestion, inhalation of volatiles and particulates from soil, and dermal contact with soil should be used (please note that the equation provided in Section IX of this memorandum for Standard 2, although different, yields an identical Soil MSC value as the equation provided below for Standard 3. The difference between the two equations is that the equation for Standard 2 calculates an intake dose for the inhalation pathway, while the equation for Standard 3 allows for incorporation of reference concentrations (RfCs) and inhalation unit risk factors (URFs) as outlined Section X.1):

$$SoilMSC = \frac{1}{\frac{1}{MSC_{Inhalation}} + \frac{1}{MSC_{Ingestion}} + \frac{1}{MSC_{Dermal}}}$$

Where:

$MSC_{Inhalation}$ = Medium-Specific Concentration in soil for the inhalation pathway as calculated per Attachment D of this memorandum;

$MSC_{Ingestion}$ = Medium-Specific Concentration in soil for the ingestion pathway as calculated per Attachment D of this memorandum;

MSC_{Dermal} = Medium-Specific Concentration in soil for the dermal pathway as calculated per Attachment D of this memorandum.

For convenience, all soil MSC equations and default parameters for residential and commercial/industrial scenarios (inhalation, ingestion, and dermal pathways) are provided in Attachment D. In addition, as stated above, current toxicity factors are now conveniently provided in the table entitled "Toxicity Factors" on the Office of Waste Management home page on the internet

(http//:www.tnrcc.state.tx.us/waste) and the tables will be updated. In addition, recommended chemical/physical properties are provided in Attachment E of this memorandum.

X.1 Calculating Inhalation Risk

Inhalation toxicity values in the Integrated Risk Information System (IRIS) are now expressed in terms of concentration in air (RfCs and URFs) rather than in terms of dose (i.e, as for inhalation reference doses and inhalation slope factors in units of mg/kg-day). Thus, while expression of existing IRIS inhalation toxicity values as intakes is specified in the inhalation equations provided in Standard 2 of the existing rule, this conversion should not be done for Standard 3 risk assessments. Instead, the inhalation pathway should be evaluated by making direct comparisons of URFs and RfCs to measured or modeled air concentrations rather than conversions to internal doses. All contaminants should be evaluated for inhalation of particulates from soil but only those with a Henry's Law constant greater than $1x10^{-5}$ (atm-m^3/mole) should be evaluated for inhalation of volatiles from soil (in accordance with Footnote 1 of Preamble Table A of the existing rule). A total inhalation risk (i.e., risk from inhalation of particulates **AND** volatiles) should be calculated for each of the appropriate contaminants.

The algorithms presented in Attachment D of this memorandum should be used to address the inhalation route of exposure.

X.1.1 Adjustment for Less than 24-Hour

In deriving chronic RfCs and URFs, the data are adjusted to a particular set of ventilatory patterns (i.e., 20 m^3/day). However, it should be noted that the 20 m^3/day rate is based on an assumed inhalation rate of 0.4 m^3/hour during resting hours (eight hours) and 1.0 m^3/hour for 16 hours of light activity for adults. Certain workers, on the other hand, are likely to engage in moderate to strenuous activity, resulting in increased inhalation rates (e.g., 1.6 to 3.2 m^3/hour) while working (USEPA, 1997b). Therefore, even though the worker may be exposed for only a portion of the day, their inhalation rate is likely to be higher in many cases than that assumed in calculating the 20 m^3/day value. Based on the information presented above, workers are not necessarily exposed to a lesser degree simply because they are on site only a portion of the day, given that they are likely to function at an increased activity level. **Therefore, use of an adjustment factor (i.e., 8/24) with commercial/industrial exposures to account for the fact that workers are only on site a total of eight hours per day should <u>NOT</u> be allowed**. Although it could be argued that current workers at a given site are not involved in strenuous activities, inability to predict all potential activity patterns under a future-use scenario, as well as the inability to distinguish between commercial and industrial land use under the existing rule, precludes the use of an adjustment factor.

X.2. Additional Exposure Scenarios Routinely Considered Under Risk Reduction Standard Number 3

The existing rule requires that a baseline risk assessment report be prepared which describes the potential adverse effects under both current and future conditions caused by the release of contaminants in the absence of any actions to control or mitigate the release (§335.553(b)(2)). While

residential and industrial land use scenarios are the ones most commonly evaluated in risk assessments, other scenarios including occasional use scenarios such as recreational use and trespassing, are also often evaluated for many sites.

If the standard residential or commercial/industrial exposure assumptions (as outlined in Table 1 of the existing rule) are used, no additional scenarios need be evaluated. However, when deviations from the standard scenarios have been made, it may be necessary to evaluate a trespasser scenario when such exposures are plausible. The following sections describe the criteria for determining whether additional exposure scenarios need to be evaluated. In addition, as there is a general lack of reliable data concerning activity patterns for recreational users/trespassers in the open scientific literature and USEPA guidance documents, the agency has developed a generic trespasser scenario as a means of promoting consistency across sites, as well as to facilitate progress in moving sites to closure. The default assumptions presented in Table D1 of Attachment D have been provided to aid reviewers in evaluating whether risks to trespassers resulting from exposure to contaminated soil have been adequately evaluated in risk assessments submitted under the existing rule. The pathways and default exposure parameters provided in Table D1 of Attachment D are specific to soil exposures. In cases where there is a potential for exposure to contaminated surface water or shallow groundwater, TARA should be contacted for the appropriate pathways, equations, and exposure factors. In certain site-specific cases, it may be more appropriate to use alternative assumptions to those presented in Table D1 of Attachment D if the responsible party can provide documented and verifiable information on activity patterns for trespassers.

X.2.1 Trespasser

A trespasser scenario should be evaluated only in those circumstances in which deviations from the standard assumptions for residential and commercial/industrial scenarios (as outlined in Table 1 of the existing rule) have been made and where such exposures are plausible. It should be noted that for active operating facilities, where elaborate security measures are in place to prevent site access, it may not be necessary to evaluate a trespasser scenario. However, for many of the contaminated sites regulated by the TNRCC, the site has been abandoned or is no longer an active facility, and therefore, a trespasser scenario is often included to address reasonable current conditions, which is consistent with evaluations typically required by other states, as well as USEPA Regional Offices. Clearly, the most scientifically defensible means of defining a trespasser scenario for a given site is to consider site-specific information such as site location, size, attractive features, and actual activity patterns at the site in question. However, even given such site-specific information, it is still difficult to identify appropriate exposure parameters with a high degree of confidence. Therefore, to promote consistency across sites where this scenario is considered, as well as to facilitate progress in moving sites to closure, the agency has developed the generic trespasser assumptions (Table D1 of Attachment D) to be used in the absence of better, site-specific information that is adequately documented and verifiable. The soil exposure pathways considered relevant for this scenario include ingestion of site soils, dermal exposure to site soils, and inhalation of vapors and particulates from site soils. The trespasser is assumed to be an older child (age 6 to 18), wearing a short sleeved shirt, shorts and shoes.

XI. REFERENCES

Bast, C.B. and Borges H.T., 1998, Derivation of Toxicity Values for Dermal Exposure, *The Toxicologist*, Vol. 31, No. 1, Part 2, March, 1996 (original abstract published in 1996; updated in January, 1998), Oak Ridge National Laboratory, Nashville, TN.

California Environmental Protection Agency (CalEPA), 1994. *Preliminary Endangerment Assessment Guidance Manual*, Department of Toxic Substances Control.

Conklin, A.W., Skinner, S.C., Felten, T.L., and Sanders, C.L., 1982. *Toxicol. Lett*. 11:199-203.

Cuddihy, R.G. and Griffith, W.C., 1972. A Biological Model Describing Tissue Distribution and Whole-body Retention of Barium and Lanthanum in Beagle Dogs after Inhalation and Gavage, *Health Phys*. 23:621-633.

Donaldson, R.M. and Barreras, R.F. Intestinal Absorption of Trace Quantities of Chromium, *J. Lab. Clin. Med*. 68:484-493, 1966.

Duff, R.M. and Kissel, J.C., (1996). Effect of Soil Loading on Dermal Absorption Efficiency from Contaminated Soils, *J. Tox. Environ. Health*, 48:93-106.

Elakhovskaya, N.P., 1972. The Metabolism of Nickel Entering the Organism with Water (Russian translation), *Gig Sanit* 6:20-22.

Ewing, K.J., Morgan, W.D., Zanzi, I. et al., 1979. In Vivo Measurement in Smokers and Nonsmokers, *Science* 205:323-325.

Farooqui, M.Y.H. and Ahmed, A.E., 1982. Molecular Interaction of Acrylonitrile and Potassium Cyanide with Rat Blood, *Chem. Biol. Interact*. 38:145-159.

Gilbert, R.O. 1987. *Statistical Methods for Environmental Pollution Monitoring*. Van Nostrand Reinhold Company, New York. pp.177-185.

Hecht, S.S., Grabowski, W., Groth, K., 1979. Analysis of Faeces for Benzo[a]pyrene after Consumption of Charcoal-broiled Beef by Rats and Humans, *Cosmet. Toxicology* 17:223-227.

Integrated Risk Information System (IRIS), online, 1998. USEPA National Center for Environmental Assessment.

Keller, W. and Yeary, R., 1980. A Comparison of the Effects of Mineral Oil, Vegetable Oil, and Sodium Sulfate on the Intestinal Absorption of DDT in Rodents, *Clin Toxicol*. 16:223-231.

Knopp, D. and Schiller, F., 1992. Oral and Dermal Application of 2,4-dichlorophenoxyacetic Acid Sodium and Dimethylamine Salts to Male Rats: Investigations on Absorption and Excretion as Well as Induction of Hepatic Mixed-function Oxidase Activities, *Arch. Toxicol*. 66:170-174.

Korte, F., 1978. Ecotoxicologic Profile Analysis, *Chemisphere* 1:79-102.

Lie, R., Thomas, R.G., and Scot, J.K., 1960. The Distribution and Excretion of Thallium^{204} in the Rat: Suggested MPCs and a Bioassay Procedure, *Health Phys*. 2:334-340.

MacKenzie, R.D., Anwar, R.A., Byerrum, R.U., and Hoppert, C.A., 1959. Absorption and Distribution of Cr^{51} in the Albino Rat, *Arch. Biochem. Biophys*. 79:200-205.

Michael, D. I. 1992. Planning ahead to get the quality of RI data needed for remedy selection: Applying the Data Quality Objectives (DQO) process to Superfund Remedial Investigations.

Neptune, D., Brantly, E., Messner, M., and D. Micheal. "Quantitative Decision Making in Superfund", *Hazardous Materials Control*, May-June 1990, Vol. 3-3.

Ohno, Y., Kawanishi, T., Takahashi, A., 1986. Comparisons of the Toxicokinetic Parameters in Rats Determined for Low and High Dose Gamma-chlordane, *J. Toxicol. Sci*, 11:111-124.

Pelletier, O., Ritter, L., and Somers, C.J., 1989. Disposition of 2,4-Dichlorophenoxyacetic Acid Dimethylamine by Fischer 344 Rats Dosed Orally and Dermally, *J. Toxicol. Environ. Health* 28:221-234.

Reeves, A.L., 1965. The Absorption of Beryllium from the Gastrointestinal Tract, *Arch. Environ. Health* 11:209-214

Ruoff, W. 1995. Relative Bioavailability of Manganese Ingested in Food or Water, Proceedings Workshop on the Bioavailability and Oral Toxicity of Manganese, USEPA-ECAO, Cincinnati, OH.

Sayato, Y., Nakamuro, K., Matsui, S., Ando, M., 1980. Metabolic Fate of Chromium Compounds. I.. Comparative Behavior of Chromium in Rat Administered with $Na_2{}^{51}CrO_4$ and $^{51}CrCl_3$, *J. Pharm. Dyn*. 3:17-23.

Strickland, G.T., Beckner, W.M., and Leu, M.L., 1972. *Clin. Sci*. 43:617-625.

Taylor, D.M., Bligh, P.H., and Duggan, M.H., 1962. The Absorption of Calcium, Strontium, Barium, and Radium from the Gastrointestinal Tract of the Rat, *Biochem. J*. 83:25-29.

USEPA, 1989a. Risk Assessment Guidance Document for Superfund, Vol. I, Human Health Evaluation Manual (Part A), Interim Final. EPA/540/1-89/002.

USEPA, 1989b. Methods for Evaluating the Attainment of Cleanup Standards, Vol. 1: Soils and Solid Media. EPA 230/02-89-042. February, 1989.

USEPA, 1991. Exposure Point Concentrations in Groundwater, EPA/903/8-91/002, Region III, Office of Superfund, Hazardous Waste Management, November 1991.

USEPA, 1992a. Guidance for Data Useability in Risk Assessment (Part A), Final. 9285.7-09A

USEPA, 1992b. Supplemental Guidance to RAGS: Calculating the Concentration Term. PB92-963373.

USEPA, 1992c. Draft Guidance on the Selection of Analytical Metal Results from Monitoring Well Samples for Use in the Quantitative Estimation of Risk. August, 1992.

USEPA, 1992d. Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Draft Addendum to Interim Final Guidance. July, 1992.

USEPA, 1992e. Dermal Exposure Assessment: Principles and Applications. EPA/600/8-91/011B, 1992.

USEPA, 1992f. Control of Air Emissions from Superfund Sites. EPA/625/R-92/012. November, 1992.

USEPA, 1992g. Memorandum: Guidance on Risk Characterization for Risk Managers and Risk Assessors: F. Henry Habicht II, Deputy Administrator, Washington, D.C.

USEPA, 1994a. Region 8 Superfund Technical Guidance. SOP#RA-03. January, 1994.

USEPA, 1994b. USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review. PB94-963502. EPA 540/R-94/013. February, 1994.

USEPA, 1994c. USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review. PB94-963501. EPA 540/R-94/012. February, 1994.

USEPA, 1995. Supplemental Guidance to RAGS: Region 4 Bulletins Human Health Risk Assessment, Interim. November, 1995.

USEPA, 1996a. Guidance for Data Quality Assessment. EPA/600/R-96/084. July 1996.

USEPA, 1996b. Low-Flow (Minimal Drawdown) Groundwater Sampling Procedures. EPA/540/S-95/504. April 1996.

USEPA, 1997a. Health Effects Assessment Summary Tables (HEAST), FY 1997 Update. Office of Solid Waste and Emergency Response. EPA-540-R-97-036, PB97-921199, July 1997.

USEPA, 1997b. Exposure Factors Handbook, Vol. I. EPA/600/P-95/002Fa. August, 1997.

Waitz, J.A., Ober, R.E., Meisenhelder, J.E., and Thompson, P.E., 1965. *WHO Bulletin* 33:357-546

Wester, R.C., Maibach, H.I., Bucks, D.A.W., Sedik, L., Melendres, J., Liao, C., DiZio, S., 1990. Percutaneous Absorption of [^{14}C]DDT and [^{14}C]Benzo[a]pyrene from Soil, *Fund. Appl. Toxicol*. 15:510-516.

Wester, R.C., Maibach, H.I., Sedik, L., Melendres, J., Liao, C., DiZio, S., 1992a. Percutaneous Absorption of [14C] Chlordane from Soil, *J. Toxicol. Environ. Health* 35:269-77.

Wester, R.C., Maibach, H.I., Sedik, L., Melendres, J., DiZio, S., Wade, M., 1992b. *In Vitro* Percutaneous Absorption of Cadmium From Water and Soil Into Human Skin, *Fund. Appl. Toxicol.* 19:1-5.

Wester, R.C., Maibach, H.I., Sedik, L., Melendres, J., Wade, M., DiZio, S., 1993c. Percutaneous Absorption of Pentachlorophenol From Soil, *Fund. Appl. Toxicol.* 20:68-71.

Wester, R.C., Melendres, J., Logan, F., Hui, X., Maibach, H.I., Wade, M., Huang, K-C, 1996. Percutaneous Absorption of 2,4-Dichlorophenoxyacetic Acid From Soil With Respect to Soil Load and Skin Contact Time: *In Vivo* Absorption in Rhesus Monkey and *In Vitro* Absorption in Human Skin, *J. Toxicol. Environ. Health* 47:335-344.

Young, V.R., Nahapetian, A., Janghorbani, M., 1982. Selenium Bioavailability with Reference to Human Nutrition, *Am. J. Clin. Nutr*. 35:1076-1088.

Attachment A
Recommended Data Reporting Procedures

A.1. Data reported to the TNRCC should be in summary tables prepared for all environmental samples, including field duplicates. These summary tables should include the following:

a. Both the detected and non-detected analytical results for each contaminant, on a dry weight basis.

b. If required for the project, the analytical results for each tentatively identified compound (TIC). Except for low concentration water analyses, the analytical results of the largest peaks which are not system monitoring compounds, internal standards, or target compounds, and which have area or height greater than 10% of the area or height of the nearest internal standard, should be reported. For low water concentration analyses, the results of the largest peaks which meet the above criteria, but are 40% of the area or height of the internal standard, should be reported. For medium to high concentration water analyses, the search can be limited to the NIST library. In areas of known contamination or where the associated process knowledge exists, the executive director may determine that the results for TICs may not be required. The mass spectra search must include the NIST/EPA/NIH and/or Wiley mass spectral library for low concentration water analyses.

c. The method detection limit used by the laboratory during the analyses of the samples.

d. The method quantitation limit (MQL) which is the lowest non-zero standard in the calibration curve.

e. The sample location (including depth, if applicable), the sample ID#, the date sampled, the preparation method number, and the analytical method number.

f. The % moisture of the sample for soils and sediments.

g. The data qualifiers applied to the sample results.

h. The footnotes which include the source and definition for each data qualifier used.

A.2. The data reported in these summary tables should be reported in the following manner:

a. Measurements which are within the linear range of the calibration above the quantitation limit (i.e., the lowest non-zero standard in the initial calibration curve) should be reported as the values measured. Samples that have contaminants measured above the linear range of the calibration (i.e., above the highest initial calibration standard) should be diluted, or otherwise manipulated in the laboratory, and reanalyzed until the measurements are within the linear range of the instrument. For

diluted samples, the results from the lowest dilution, for which the contaminant is measured within the linear range of the calibration curve, should be reported in the data summary tables and flagged with a "D" to indicate the result is based on a diluted sample.

b. Measurements between the method quantitation limit and the method detection limit should be reported as the value estimated by the laboratory. The value should be flagged with an alpha character to indicate that the contaminant is present but the value is an estimate.

c. Measurements below the value equal to the method detection limit should be censored and reported as less than the numerical value equal to the method detection limit (e.g., <5 ug/L).

d. Alpha characters used as qualifiers, based on the data review, should be assigned to the data in the summary report.

A.3. Recommended flagging criteria are as follows (Note: qualified data can not be used unless the data qualifiers are clearly defined in the laboratory case narrative and/or in the data review report):

"U" - The contaminant was analyzed for, but was not detected above the level of the associated value. The associated value is the sample quantitation limit.

"J" - The contaminant was positively identified and the associated value is an estimated concentration.

"R" - The associated value is not usable. The contaminant may, or may not, be present.

"UJ" - The contaminant was analyzed for, but was not detected. The associated value is an estimate and may be inaccurate or imprecise.

"N" - The analysis indicates the presence of the contaminant for which presumptive evidence exists to make a "tentative identification."

"NJ" - The analysis indicates the presence of the contaminant that has been "tentatively identified" and the associated value represents its estimated concentration.

"D" - The result is from a diluted sample.

"E" - The measurement exceeds the upper calibration limit, therefore, the concentration is estimated.

A.4. Quality Control Data Report

a. At a minimum, the laboratory should generate the quality control data listed in Table A.1 for each method, as applicable. Of those data only the following need to be submitted to the TNRCC. All of the data generated for the project should be available upon request by the TNRCC:

- completed chain of custody documentation;
- the laboratory analysis data sheets or certificate of analysis sheets. For samples that are diluted by the laboratory, the results of all dilution runs should be reported;
- sample receipt and log-in information;
- laboratory case narrative (see item d. below);
- data from all of the blanks (e.g., method, trip, rinse, and field blanks);
- the surrogate recovery data for organic analyses;
- the post digestion spike recovery data for inorganic analyses;
- the matrix spikes, matrix duplicates, and matrix spike duplicates recovery and precision data;
- the laboratory control samples recovery data and the laboratory control duplicates recovery and precision data, if applicable;
- the sample receipt and log-in data;
- initial calibration summary data; and
- the sample run log.

The identity of each sample batch should be unambiguously reported with the results so that a reviewer can identify the quality control samples and the associated environmental samples.

In addition, the results of any performance evaluations studies performed can be submitted to the TNRCC.

b. The report should include a table presenting the sample identification number, the date of sample collection, the date of extraction/digestion, the date of analysis, the analyst(s) initials, and whether the sample was properly preserved upon receipt by the laboratory.

c. The report should include a table that cross-references current field location numbers with any historically used field location numbers, the field/sample ID numbers with the laboratory ID numbers, and the associated QC batch control numbers.

d. The laboratory case narrative for each sample batch should be included. The case narrative should reference the method and the laboratory's standard operating procedures (SOP), discuss any deviation from the method and/or the SOP, and discuss any problems or anomalies observed in the data that might affect the quality

of the data. The case narrative must include the name, title, and signature of the laboratory manager responsible for the release of the data.

Table A.1
Laboratory Quality Control Data

ORGANIC DATA	INORGANIC DATA
Chain of custody documentation [1]	Chain of custody documentation[1]
Sample receipt and log-in information[1]	Sample receipt and log-in information[1]
Laboratory case narrative[1]	Laboratory case narrative[1]
Surrogate recovery data[1]	Matrix spike/matrix spike duplicate recovery and precision data[1]
Matrix spike/matrix spike duplicate recovery and precision data[1]	Duplicate recovery and precision data[1]
Duplicate recovery and precision data[1]	Laboratory control sample recovery data[1]
Laboratory control sample recovery data[1]	Method blank data[1]
Method blank data[1]	ICP interference check sample
GC/MS tuning data	Post digestion spike recovery data[1]
Internal standard area and retention time summary	Method of standard addition (MSA) information if required
Sample preparation information	Sample preparation information
Sample summary results[1]	Sample summary results[1]
Sample quantitation report	Raw sample data, instrument output
Sample chromatograms	Initial calibration summary data[1]
Sample spectra	Continuing calibration
Sample instrument run log	Raw sample data
Initial calibration summary data[1]	Instrument run log[1]
Continuing calibration	Standard and reagent traceability documentation
Quantitation reports	Method detection limit studies
Chromatographs	
Instrument run log[1]	
Standard and reagent traceability documentation	
Method detection limit studies	

[1] These items, including applicable acceptance criteria, should be included in the data submitted to the agency. All other items listed provide for traceable QC documentation and should be made available upon request by the agency.

Attachment B
General Discussion of Analytical Terms and Issues

B.1. Detection Limits and Quantitation Limits

At very low concentrations it is impossible for analytical instruments to tell the difference between signals from analytes and signals created by random noise in the instrument. Therefore, the laboratory cannot report a concentration of zero for an analyte and must report some concentration limit above which it can "see" the signal from the analyte.

There is much confusion concerning the strict definitions of these reporting limits, which are usually called "quantitation limits" or "detection limits." In many cases, the various terms have been used as if they were equivalent or have been used erroneously. In other cases, these terms have been used instead of the more precisely defined terms (e.g., sample quantitation limit, method detection limit, method quantitation limit, etc.). The following discussion is intended to provide an understanding of the various types of detection and quantitation limits, as well as the relationship between them.

B.1.1. Definitions of Reporting Terms

B.1.1.1. Instrument Detection Limit

The Instrument Detection Limit (IDL) is the lowest concentration of a compound that can be detected by the analytical instrument, above the background noise level of the instrument. The IDL is defined in 40 CFR 136 Appendix B as

> "three times the standard deviation of seven replicate analyses of the substance (analyte) at the lowest concentration level that is statistically different from a blank."

This represents a 95% confidence that the signal identified is the result of the presence of the analyte, not random noise. The IDL is usually determined by analyzing solutions of the analyte in laboratory reagent-grade solvent. Since the IDL is dependent only on the instrument stability and sensitivity, it does not reflect a measurement of the effects of sample preparation, concentration or dilution, or the sample matrix. IDLs should be derived for each instrument.

B.1.1.2. Method Detection Limit

The Method Detection Limit (MDL) is defined as

> "...the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from the analysis of a sample in a given matrix type containing the analyte." (Chapter One, SW-846, 1992).

The MDL should be derived by each laboratory on an annual basis for each compound for each method using the procedures that meet or exceed the requirements in 40 CFR Part 136 Appendix B. Currently, the method for estimating the MDL outlined in 40 CFR is under review by the EPA and other entities. Until the issue is resolved, the MDL should be estimated using a procedure that meets, or exceeds, the guidance outlined in Chapter One, SW-846, 1992 and should include the iterative procedure outlined in step 7 of 40 CFR to verify the reasonableness of the estimated MDL value. The procedure is based on analyzing 7 replicates of a laboratory reagent-grade matrix spiked at a concentration that is equal to the laboratory's estimated MDL. The derived MDL is calculated using the student's t-test at a 99% confidence level.

If the laboratory has several instruments used for the same analyses, the MDL should be derived for each instrument. An MDL study should be on file for each instrument for each analyte for each method. It is acceptable for the laboratory to assign the highest MDL to all the instruments. However, it is not acceptable for the laboratory to perform an MDL study on only one of the instruments and then assign that MDL to all of the instruments. The laboratory should keep documentation of current MDL studies readily available for review by the clients of the laboratory or authorized representatives of the appropriate regulatory authorities.

The MDL studies are conducted using clean reagent-grade matrix spiked with the compounds of interest. Therefore, the MDLs do not account for potential effects from the environmental sample matrix, from the use of different initial laboratory sample sizes or dilutions, etc.; all of these factors can affect the laboratory's ability to "see" the compound. Therefore, the MDL may not accurately reflect the level at which a compound can be detected in a given set of environmental samples. The MDL for a particular analyte should not vary from sample to sample within the same laboratory using the same method unless different instruments were used; however, the MDL for a particular analyte may vary from laboratory to laboratory.

B.1.1.3. Method Quantitation Limit

The Method Quantitation Limit (MQL) is currently defined as:

> "the lowest concentration calibration standard that is analyzed during an initial calibration..." (Method 8000B, Section 7.4, SW-846, 1996).

When determining the MQL for an analytical method, the laboratory first estimates the concentration of the MQL using such sources as the practical or estimated quantitation limit published with the method (for example from SW-846 or 40 CFR), and calibrates the instrument using that estimated concentration as the lowest non-zero standard. If the generated calibration curve meets the method specified acceptance criteria, that lowest non-zero standard concentration documents the MQL. The MQL is significant because it defines the demonstrated lower limit of the linear range of the instrument and it should correspond to a sample concentration at or below the level of interest for the project (e.g. action level, regulatory limit, remedial goal, health-based concentration, etc.).

B.1.1.4. Practical Quantitation Limit (PQL) as Defined in 30 TAC 335

In 1993 the TNRCC defined the PQL in the Risk Reduction Rules (30 TAC Chapter 335 Subchapter S) to be:

> "The lowest concentration of an analyte which can be reliably quantified within specified limits of precision and accuracy during routine laboratory operating conditions. The PQL minimizes to the extent possible the effects of instrument and operator variability and the influences of the sample matrix and other contaminants or substances upon the quantitation of the analyte. 'Specified limits of precision and accuracy' are the criteria which have been included in applicable regulations or which are listed in the quality control sections of the analytical method. The PQL may be directly obtained or derived from the following sources with preference given to the most recent, scientifically valid method: federal regulations; EPA guidance documents; calculation from inter-laboratory studies; and experimentally determined analytical methods not available from other existing sources." 30 TAC §335.552.

The PQL should be directly obtained from the laboratory's calibration of the instrument for the method used to generate the data reported to the agency. The PQL should be equal to the lowest non-zero standard in the calibration curve. Therefore the PQL, as the term is used in 30 TAC 335, is analogous to the MQL as it is currently defined in Update III of *Test Methods for Evaluating Solid Waste* (SW-846, 1996).

B.1.1.5. Practical Quantitation Limit (PQL) as Defined in SW-846

The PQL was initially defined in SW-846 as:

> "... the lowest level that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions." (SW-846, 1986).

The EPA rationale for providing PQLs in the guidance was to give the laboratory guidance on what concentration could be used as the low concentration standard in the laboratory calibration curve. However, laboratories began defaulting to the PQL value provided in the guidance instead of actually determining the lowest quantifiable concentration through laboratory specific studies. To redirect the laboratories, the EPA changed the term PQL to "Estimated Quantitation Limit" (EQL) in 1992 to emphasize that the value associated with the EQL was an estimate, and not a method defined quantity. The EQL was defined in the 1992 update of SW-846 as:

> "...the lowest concentration that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions... For many analytes the EQL analyte concentration is selected as the lowest non-zero standard in the calibration curve..."

B.1.1.6. Sample Quantitation Limit

The Sample Quantitation Limit (SQL) is the MQL adjusted to reflect sample-specific action(s) performed by the laboratory that are necessary but not prescribed in the method. The SQL takes into account the individual sample matrix characteristics, sample preparation, and analytical adjustments. Therefore, the SQLs are the most relevant quantitation limits for evaluating nondetected compounds in specific samples. The SQL in one sample may be higher than, lower than, or equal to the SQL values for the same contaminant in another sample. For example:

> Carbon tetrachloride is present in a sample at high concentration and chloroform is present in the same sample at a relatively low concentration. The sample is diluted 100-fold to allow for measurement of the carbon tetrachloride causing the SQL for both compounds to be raised by a factor of 100. The analyst is still able to "see" the carbon tetrachloride because the concentration in the diluted sample is above the SQL for carbon tetrachloride; however, the concentration of the chloroform in this analysis is below the SQL for chloroform.
>
> If the sample was not run at a lower dilution in addition to this run at a high dilution (100 times), the data user could only conclude that chloroform was not present at a concentration greater than 100 times the MQL for chloroform.
>
> However, if the sample had been run at a lower dilution that allowed for the quantitation of the chloroform or a lower SQL for chloroform, the data user would be better informed.

Some samples may require dilution in order to bring one or more analytes within calibration range or to overcome significant interferences with some analytes. For samples that are diluted by the laboratory, the results of all dilution runs should be provided to the data user to maximize the useability of both detected results and nondetected results. It is important that use of the PQL or MQL values as measures of sample quantitation should be avoided except where the SQL is equal to the MQL.

B.2. Selecting the Correct Analytical Procedure

Selection of appropriate analytical methods is critical to the acquisition of usable data for calculating the concentration term. Appropriate analytical methods should have quantitation limits which are below the risk-based values for the chemicals of potential concern (COPCs) and have sufficient quality assurance and quality control (QA/QC) requirements to ensure confident target analyte identification and quantitation.

In order to characterize the contaminants at a site, samples should initially be analyzed using broad-spectrum methods such as SW-846 Methods 8260 and 8270B. Such methods provide definitive identification of COPCs by employing instrumental techniques such as mass spectrometry. Once broad-spectrum analyses and identification of COPCs have been performed, analyte-specific methods that quantify specific COPCs at lower analytical limits should be used where necessary.

For example, Method SW-846-8270B is a broad-spectrum analysis for semivolatile organic compounds. The practical quantitation limit (PQL)/estimated quantitation limit (EQL) provided by USEPA in that method for pentachlorophenol in water is 0.05 mg/l. The health-based value for pentachlorophenol in water based upon human ingestion is 0.001 mg/l. If pentachlorophenol is identified as a COPC at the site based on historical knowledge and/or using SW-846-8270B, then the person should plan to use another analytical method, such as SW-846-8151, which has a quantitation limit that is sufficiently low to determine whether pentachlorophenol is present at a concentration above the risk-based cleanup level when sampling to demonstrate closure or maximum extent.

Since the more sensitive analytical methods do not readily provide qualitative confirmation of a COPC's identity, the person evaluating a site should consider minimizing the risk of false positive identifications by confirming the results on some minimal frequency through a second analysis with a dissimilar detector or chromatographic column. It is important that sample matrices are well defined and analytical conditions be stable when using less compound-specific detection methods. Guidance on selecting the analytical method, sample collection techniques, and analytical methodologies described in the most recent version of the USEPA's *SW-846, Test Methods for Evaluating Solid Waste* (SW-846) should be used.

B.3. Qualifying Data

Most USEPA methods include specific QA/QC procedures and control limits. These limits generally define when an analytical run (a batch of individual samples plus the associated QC blanks, spikes, and standards) has met the method requirements. If the method requirements are not met, the laboratory is required to take corrective action to correct the problem which may include reanalyzing the entire batch of samples. If the corrective actions are not taken or are not effective, the laboratory is required to advise the data user regarding the quality of the data. These method-specified QA/QC limits are generally fairly broad. Therefore, SW-846 requires that the laboratory establish laboratory specific QC acceptance criteria. These laboratory-specified limits must be within the method-specified limits.

The data user must assess the useability of the data for each COPC to determine if the quality meets the project objectives. For example, when a multi-analyte method (such as Method 8270) is run, certain analytes must be within QC limits to demonstrate that the method was performed properly. If the data user is interested in a particular constituent that was not within QC limits, then the data user must determine if the associated data need to be qualified as estimated or unusable.

The basis on which data are qualified may vary. Many data reviewers use the guidelines developed by USEPA for evaluating data generated under the Contract Laboratory Program (CLP). The CLP was developed by USEPA for laboratories performing analyses for the federal Superfund program. These guidelines are entitled *"USEPA National Functional Guidelines for Inorganic Data Review"* (1994b) and *"USEPA National Functional Guideline for Organic Data Review*" (1994c). The documents are commonly referred to as the National Functional Guidelines (NFGs). While a number of QC requirements in the NFGs are specific to the CLP, many of the guidelines are applicable to

non-CLP analyses. These documents contain specific reporting requirements, control limits for data review parameters and advice for qualifying data that are outside of control limits. Although not all of the requirements in these documents apply to non-CLP laboratory data, they are a good source for general QC limits that can be used to evaluate data in the absence of other guidance. Note: the laboratory is required only to meet the project and/or method-specified QC acceptance criteria. If the laboratory was not performing the CLP method, not all of the criteria specified in the NFGs will be applicable to the laboratory or the data.

Generally analytical data can be divided into three types: quantitative, qualitative, and unusable. Quantitative data are data for which all of the applicable QC criteria were met. They can be used directly in calculating a concentration term. Qualitative data are data that did not meet all of the QC criteria, but are considered acceptable as estimated and can be used in calculating a concentration term provided that the uncertainty associated with the data is discussed in the risk assessment. Unusable data are data for which the quality of the data cannot be determined. For example, data would be qualified as unusable because the supporting QC documentation for the data is not available or one or more of the QC parameters has been grossly exceeded. It is important to note, if a significant portion of the data set being used to calculate a concentration term consists of estimated data, the data user should be aware of the additional uncertainty in the risk calculations. In summary, both quantitative and qualitative (i.e., estimated) data should be used in calculating a concentration term, but data qualified as unusable are not usable for any purpose.

Qualified data should be flagged with a "data qualifier." Note: Qualified data should not be used unless the data qualifiers are clearly defined in the laboratory report and/or the data user's review report.

In many cases, analytical data received from laboratories already include data qualifiers (e.g., E or N flags). These qualifiers should be used by the person to review the data and determine its useability. In so doing, additional qualifiers may need to be added to indicate whether the data are considered to be estimated or unusable. **The ultimate responsibility for reviewing and qualifying the data for usability lies with the person responding to the rule, not the laboratory.**

B.4 Reviewing Data

Currently, neither the USEPA nor the TNRCC has guidelines in place for reviewing analytical data other than the NFGs. Therefore, the following guidance is provided for use when reviewing data using the NFGs. **Note:** The USEPA and/or TNRCC is drafting guidelines for reviewing non-CLP data. When issued and adopted by the TNRCC, these non-CLP guidelines will supersede the guidance below.

For use in reviewing non-CLP analytical data using the NFGs, the following guidance is provided:

1. The person responding to rule should understand the objective of the QC parameter being reviewed. This information is included under the title "Objective" in the NFGs.

2. The person should compare the project criteria and method criteria to the "Criteria" in the NFGs. If the project criteria are not specified, the method criteria should be used to evaluate the data. If neither the project nor method criteria are specified, the person should evaluate the NFG criteria and apply those criteria that are applicable. Note: The project and/or method specified criteria always supersede the NFG criteria.

3. The person should review the "Evaluation" specified in the NFGs and understand the method of evaluating the laboratory's QC results against the NFG criteria. Note: Not all the calculations specified in the NFGs are applicable to non-CLP analytical methods.

4. The person should flag the data specified in the "Action."

5. The person who is purchasing the data should be considered the Technical Project Officer (TPO). The NFGs specify when the TPO should be notified, such as when the QC criteria are grossly exceeded due to laboratory performance.

6. The person should understand that specific reference to the Target Analyte List (for inorganics) and the Target Compound List (for organics) is CLP specific, however, these terms can be construed to be the project-specified analyte or compound list. Note: The project-specified analyte or compound list always supersedes the NFG criteria.

7. The person should understand that the terms Contract Required Detection Limit (CRDL) and Contract Required Quantitation Limit (CRQL) are CLP specific; however, these terms can be construed to be project-required detection and quantitation limits. Note: The project-specified limits always supersede the guideline criteria.

8. The person should understand that references to INORG Sections or ORG Sections are referring to the actual contracted Statement of Work between EPA and its contracted laboratory; however, where applicable, these references can be construed to be references to the applicable sections within the analytical method used by the laboratory when the data were generated.

9. The person should understand that the CRI and CRA referred to in the inorganic NFGs can be construed to be the laboratory control sample spiked with the analyte of interest at a concentration at or below the level of interest (i.e., the action level, the preliminary remedial goal, etc).

10. The person should understand that the term "low concentration water" in the organic NFGs refers to samples where a compound concentration is thought to be significantly reduced (i.e., less than 15% of the total sample).

11. The NFGs imply that a laboratory control sample is only necessary when a low concentration water method is used. The person should note that all data submitted to the TNRCC must be associated with a laboratory control sample spiked with the project-related analytes of interest.

12. The use of blind or double-blind performance evaluation (PE) samples is strongly encouraged by the TNRCC to monitor laboratory performance using non-environmental matrix (i.e., a laboratory defined and documented matrix). The results of the PE samples may be submitted to the TNRCC, but should be submitted to the TNRCC if action is warranted.

Attachment C: Dermal and GI Absorption Factors					
COC	**CAS #**	**ABS.gi (unitless)**	**Reference**	**ABS.d (unitless)**	**Reference**
Acenaphthene	83-32-9	8.9E-01	Hecht, 1979	1.3E-01	Wester *et al*., 1990
Acenaphthylene	208-96-8	8.9E-01	Hecht, 1979	1.3E-01	Wester *et al*., 1990
Acetaldehyde	75-07-0	8.0E-01	default[a]	0.0E+00	default[b]
Acetone	67-64-1	8.3E-01	Bast and Borges, 1998	0.0E+00	default[b]
Acetone cyanohydrin	75-86-5	5.0E-01	default[a]	1.0E-01	default[b]
Acetonitrile	75-05-8	8.0E-01	default[a]	0.0E+00	default[b]
Acetophenone	98-86-2	5.0E-01	default[a]	1.0E-01	default[b]
Acifluorfen, sodium	62476-59-9	5.0E-01	default[a]	1.0E-01	default[b]
Acrolein	107-02-8	8.0E-01	default[a]	0.0E+00	default[b]
Acrylamide	79-06-1	5.0E-01	default[a]	1.0E-01	default[b]
Acrylic acid	79-10-7	8.0E-01	default[a]	0.0E+00	default[b]
Acrylonitrile	107-13-1	8.0E-01	default[a]	0.0E+00	default[b]
Alachlor	15972-60-8	5.0E-01	default[a]	1.0E-01	default[b]
Aldicarb	116-06-3	5.0E-01	default[a]	1.0E-01	default[b]
Aldicarb sulfone	1646-88-4	5.0E-01	default[a]	1.0E-01	default[b]
Aldrin	309-00-2	5.0E-01	Bast and Borges, 1998	1.0E-01	default[b]
Allyl alcohol	107-18-6	8.0E-01	default[a]	0.0E+00	default[b]
Allyl chloride	107-05-1	8.0E-01	default[a]	0.0E+00	default[b]
Aluminum	7429-90-5	1.0E-01	Bast and Borges, 1998	1.0E-02	default[b]
Aminopyridine, 4-	504-24-5	5.0E-01	default[a]	1.0E-01	default[b]
Ammonia	7664-41-7	2.0E-01	default[a]	1.0E-02	default[b]
Aniline	62-53-3	5.0E-01	default[a]	1.0E-01	default[b]

Attachment C: Dermal and GI Absorption Factors					
COC	**CAS #**	**ABS.gi (unitless)**	**Reference**	**ABS.d (unitless)**	**Reference**
Anthracene	120-12-7	8.9E-01	Hecht, 1979	1.3E-01	Wester *et al*., 1990
Antimony	7440-36-0	1.5E-01	Waitz, 1965	1.0E-02	default[b]
Aramite	140-57-8	5.0E-01	default[a]	1.0E-01	default[b]
Arsine	7784-42-1	2.0E-01	default[a]	1.0E-02	default[b]
Asbestos	1332-21-4	2.0E-01	default[a]	1.0E-02	default[b]
Atrazine	1912-24-9	5.0E-01	default[a]	1.0E-01	default[b]
Barium	7440-39-3	7.0E-02	Taylor, 1962; Cuddihy and Griffith, 1972	1.0E-02	default[b]
Benzene	71-43-2	9.7E-01	Bast and Borges, 1998	0.0E+00	default[b]
Benzenethiol	108-98-5	8.0E-01	default[a]	0.0E+00	default[b]
Benzidine	92-87-5	8.0E-01	Bast and Borges, 1998	1.0E-01	default[b]
Benz-a-anthracene	56-55-3	8.9E-01	Hecht, 1979	1.3E-01	Wester *et al*., 1990
Benzo-a-pyrene	50-32-8	8.9E-01	Hecht, 1979	1.3E-01	Wester *et al*., 1990
Benzo-b-fluoranthene	205-99-2	8.9E-01	Hecht, 1979	1.3E-01	Wester *et al*., 1990
Benzo-k-fluoranthene	207-08-9	8.9E-01	Hecht, 1979	1.3E-01	Wester *et al*., 1990
Benzo-g,h,i-perylene	191-24-2	8.9E-01	Hecht, 1979	1.3E-01	Wester *et al*., 1990
Benzoic acid	65-85-0	1.0E+00	Bast and Borges, 1998	1.0E-01	default[b]
Benzotrichloride	98-07-7	5.0E-01	default[a]	1.0E-01	default[b]
Benzyl alcohol	100-51-6	6.6E-01	Bast and Borges, 1998	1.0E-01	default[b]
Benzyl chloride	100-44-7	8.0E-01	default[a]	0.0E+00	default[b]
Beryllium	7440-41-7	7.0E-03	Reeves, 1965	1.0E-02	default[b]
Biphenyl, 1,1-	92-52-4	5.0E-01	default[a]	1.0E-01	default[b]
Bis (2-chloro-ethyl) ether	111-44-4	8.0E-01	default[a]	0.0E+00	default[b]

Attachment C:
Dermal and GI Absorption Factors

COC	CAS #	ABS.gi (unitless)	Reference	ABS.d (unitless)	Reference
Bis (2-chloroisopropyl) ether	39638-32-9	5.0E-01	default[a]	1.0E-01	default[b]
Bis (2-chloromethyl) ether	542-88-1	8.0E-01	default[a]	0.0E+00	default[b]
Bis (2-ethyl-hexyl) phthalate	117-81-7	1.9E-01	Bast and Borges, 1998	1.0E-01	default[b]
Bromodichloromethane	75-27-4	9.8E-01	Bast and Borges, 1998	0.0E+00	default[b]
Bromoform	75-25-2	6.0E-01	Bast and Borges, 1998	0.0E+00	default[b]
Bromomethane	74-83-9	8.0E-01	default[a]	0.0E+00	default[b]
Butadiene, 1,3-	106-99-0	8.0E-01	default[a]	0.0E+00	default[b]
Butanol, n-	71-36-3	8.0E-01	default[a]	0.0E+00	default[b]
Butylate	2008-41-5	5.0E-01	default[a]	1.0E-01	default[b]
Butyl benzyl phthalate	85-68-7	6.1E-01	Bast and Borges, 1998	1.0E-01	default[b]
Cacodylic acid	75-60-5	5.0E-01	default[a]	1.0E-01	default[b]
Cadmium	7440-43-9	2.5E-02	IRIS, 1998	1.0E-02	Wester *et al*., 1992a; USEPA, 1992e
Captan	133-06-2	5.0E-01	default[a]	1.0E-01	default[b]
Carbaryl	63-25-2	5.0E-01	default[a]	1.0E-01	default[b]
Carbazole	86-74-8	7.0E-01	Bast and Borges, 1998	1.0E-01	default[b]
Carbofuran	1563-66-2	5.0E-01	default[a]	1.0E-01	default[b]
Carbon disulfide	75-15-0	6.3E-01	Bast and Borges, 1998	0.0E+00	default[b]
Carbon tetrachloride	56-23-5	6.5E-01	Bast and Borges, 1998	0.0E+00	default[b]
Carbosulfan	55285-14-8	5.0E-01	default[a]	1.0E-01	default[b]
Chloral	75-87-6	8.0E-01	default[a]	0.0E+00	default[b]
Chlordane	57-74-9	8.0E-01	Ohno, 1986; Ewing, 1985	4.0E-02	Wester *et al*., 1992b

Attachment C: Dermal and GI Absorption Factors					
COC	CAS #	ABS.gi (unitless)	Reference	ABS.d (unitless)	Reference
Chlorine	7782-50-5	2.0E-01	default[a]	1.0E-02	default[b]
Chloroanaline, p-	106-47-8	5.0E-01	default[a]	1.0E-01	default[b]
Chlorobenzene	108-90-7	3.1E-01	Bast and Borges, 1998	0.0E+00	default[b]
Chlorobenzilate	510-15-6	5.0E-01	default[a]	1.0E-01	default[b]
Chloro-1,3-butadiene, 2-	126-99-8	8.0E-01	default[a]	0.0E+00	default[b]
Chlorodifluoromethane	75-45-6	8.0E-01	default[a]	0.0E+00	default[b]
Chloroethane	75-00-3	8.0E-01	default[a]	0.0E+00	default[b]
Chloroform	67-66-3	2.0E-01	Bast and Borges, 1998	0.0E+00	default[b]
Chloromethane	74-87-3	8.0E-01	default[a]	0.0E+00	default[b]
Chloronaphthalene, 2-	91-58-7	8.9E-01	Hecht, 1979	1.3E-01	Wester *et al*., 1990
Chlorophenol, 2-	95-57-8	8.0E-01	default[a]	0.0E+00	default[b]
Chlorotoluene, o-	95-49-8	8.0E-01	default[a]	0.0E+00	default[b]
Chlorpyrifos	2921-88-2	5.0E-01	default[a]	1.0E-01	default[b]
Chromium (III)	16065-83-1	1.3E-02	Donaldson and Barreras, 1966; Keim,	1.0E-02	default[b]
Chromium (VI)	18540-29-9	2.5E-02	Donaldson and Barreras, 1966; Sayto, 1980; MacKenzie,	1.0E-02	default[b]
Chrysene	218-01-9	8.9E-01	Hecht, 1979	1.3E-01	Wester *et al*., 1990
Cobalt	7440-48-4	8.0E-01	Bast and Borges, 1998	1.0E-02	default[b]
Copper	7440-50-8	5.7E-01	Strickland, 1972	1.0E-02	default[b]
Cresol, m-	108-39-4	5.0E-01	default[a]	1.0E-01	default[b]
Cresol, o-	95-48-7	5.0E-01	default[a]	1.0E-01	default[b]

Attachment C:
Dermal and GI Absorption Factors

COC	CAS #	ABS.gi (unitless)	Reference	ABS.d (unitless)	Reference
Cresol, p-	106-44-5	6.5E-01	Bast and Borges, 1998	1.0E-01	default[b]
Crotonaldehyde	123-73-9	8.0E-01	default[a]	0.0E+00	default[b]
Cumene	98-82-8	8.0E-01	default[a]	0.0E+00	default[b]
Cyanide	57-12-5	>5.0E-01	Farooqui and Ahmed, 1982	1.0E-02	default[b]
Cyanogen	460-19-5	8.0E-01	default[a]	0.0E+00	default[b]
Cyclohexanone	108-94-1	8.0E-01	default[a]	0.0E+00	default[b]
Cyclotrimethylenetrinitramine	121-82-4	1.0E+00	Bast and Borges, 1998	1.0E-01	default[b]
DDD	72-54-8	7.0E-01	Keller, 1980	3.0E-02	Wester *et al*., 1990
DDE	72-55-9	7.0E-01	Keller, 1980	3.0E-02	Wester *et al*., 1990
DDT	50-29-3	7.0E-01	Keller, 1980	3.0E-02	Wester *et al*., 1990
Di-n-butyl phthalate	84-74-2	1.0E+00	Bast and Borges, 1998	1.0E-01	default[b]
Di-n-octyl phthalate	117-84-0	9.0E-01	Bast and Borges, 1998	1.0E-01	default[b]
Diallate	2303-16-4	5.0E-01	default[a]	1.0E-01	default[b]
Diazinon	333-41-5	5.0E-01	default[a]	1.0E-01	default[b]
Dibenz-a,h-anthracene	53-70-3	8.9E-01	Hecht, 1979	1.3E-01	Wester *et al*., 1990
Dibromo-3-chloropropane, 1,2-	96-12-8	5.0E-01	default[a]	1.0E-01	default[b]
Dibromochloromethane	124-48-1	6.0E-01	Bast and Borges, 1998	0.0E+00	default[b]
Dicamba	1918-00-9	5.0E-01	default[a]	1.0E-01	default[b]
Dichlorobenzene, 1,2-	95-50-1	8.0E-01	default[a]	0.0E+00	default[b]
Dichlorobenzene, 1,4-	106-46-7	9.0E-01	Bast and Borges, 1998	0.0E+00	default[b]
Dichlorobenzidine, 3,3-	91-94-1	5.0E-01	default[a]	1.0E-01	default[b]
Dichloro-2-butene, 1,4-	764-41-0	8.0E-01	default[a]	0.0E+00	default[b]

Attachment C:
Dermal and GI Absorption Factors

COC	CAS #	ABS.gi (unitless)	Reference	ABS.d (unitless)	Reference
Dichlorodifluoromethane	75-71-8	2.3E-01	Bast and Borges, 1998	0.0E+00	default[b]
Dichloroethane, 1,1-	75-34-3	1.0E+00	Bast and Borges, 1998	0.0E+00	default[b]
Dichloroethane, 1,2-	107-06-2	1.0E+00	Bast and Borges, 1998	0.0E+00	default[b]
Dichloroethylene, 1,1-	75-35-4	1.0E+00	Bast and Borges, 1998	0.0E+00	default[b]
Dichloroethylene, cis-1,2-	156-59-2	1.0E+00	Bast and Borges, 1998	0.0E+00	default[b]
Dichloroethylene, trans-1,2	156-60-5	1.0E+00	Bast and Borges, 1998	0.0E+00	default[b]
Dichlorophenol, 2,4-	120-83-2	8.2E-01	Bast and Borges, 1998	1.0E-01	default[b]
Dichlorophenoxyacetic acid, 2,4-	94-75-7	>9.0E-01	Pelletier, 1989; Knopp, 1992	5.0E-02	Wester *et al*., 1996
Dichloropropane, 1,2-	78-87-5	7.4E-01	Bast and Borges, 1998	0.0E+00	default[b]
Dichloropropanol, 2,3-	616-23-9	5.0E-01	default[a]	1.0E-01	default[b]
Dichloropropene, 1,3-	542-75-6	5.5E-01	Bast and Borges, 1998	0.0E+00	default[b]
Dichlorvos	62-73-7	5.0E-01	default[a]	1.0E-01	default[b]
Dieldrin	60-57-1	5.0E-01	Bast and Borges, 1998	1.0E-01	default[b]
Diethylhexyl adipate	103-23-1	5.0E-01	default[a]	1.0E-01	default[b]
Diethyl phthalate	84-66-2	9.0E-01	Bast and Borges, 1998	1.0E-01	default[b]
Diethylstilbestrol	56-53-1	5.0E-01	default[a]	1.0E-01	default[b]
Dimethoate	60-51-5	5.0E-01	default[a]	1.0E-01	default[b]
Dimethoxybenzidine, 3,3'-	119-90-4	5.0E-01	default[a]	1.0E-01	default[b]
Dimethylbenzidine, 3,3'-	119-93-7	5.0E-01	default[a]	1.0E-01	default[b]
Dimethyl phenol, 2,4-	105-67-9	5.0E-01	default[a]	1.0E-01	default[b]
Dinitrobenzene, 1,3-	99-65-0	6.5E-01	Bast and Borges, 1998	1.0E-01	default[b]
Dinitrobenzene, 1,4-	100-25-4	5.0E-01	default[a]	1.0E-01	default[b]

Attachment C:
Dermal and GI Absorption Factors

COC	CAS #	ABS.gi (unitless)	Reference	ABS.d (unitless)	Reference
Dinitrophenol, 2,4-	51-28-5	1.0E+00	Bast and Borges, 1998	1.0E-01	default[b]
Dinitrotoluene, 2,4-	121-14-2	8.5E-01	Bast and Borges, 1998	1.0E-01	default[b]
Dinitrotoluene, 2,6-	606-20-2	8.5E-01	Bast and Borges, 1998	1.0E-01	default[b]
Dinoseb	88-85-7	5.0E-01	default[a]	1.0E-01	default[b]
Dioxane 1,4-	123-91-1	8.0E-01	default[a]	0.0E+00	default[b]
Diphenylamine	122-39-4	5.0E-01	default[a]	1.0E-01	default[b]
Diphenylhydrazine, 1,2-	122-66-7	5.0E-01	default[a]	1.0E-01	default[b]
Diquat	85-00-7	5.0E-01	default[a]	1.0E-01	default[b]
Disulfoton	298-04-4	5.0E-01	default[a]	1.0E-01	default[b]
Diuron	330-54-1	5.0E-01	default[a]	1.0E-01	default[b]
Endosulfan	115-29-7	5.0E-01	default[a]	1.0E-01	default[b]
Endothall	145-73-3	5.0E-01	default[a]	1.0E-01	default[b]
Endrin	72-20-8	2.0E-02	Bast and Borges, 1998	1.0E-01	default[b]
Epichlorohydrin	106-89-8	8.0E-01	default[a]	0.0E+00	default[b]
Ethion	563-12-2	5.0E-01	default[a]	1.0E-01	default[b]
Ethoxy ethanol, 2-	110-80-5	8.0E-01	default[a]	0.0E+00	default[b]
Ethyl acetate	141-78-6	8.0E-01	default[a]	0.0E+00	default[b]
Ethyl acrylate	140-88-5	8.0E-01	default[a]	0.0E+00	default[b]
Ethyl benzene	100-41-4	9.7E-01	Bast and Borges, 1998	0.0E+00	default[b]
Ethyl dipropylthiocarbamate, S-	759-94-4	5.0E-01	default[a]	1.0E-01	default[b]
Ethyl ether	60-29-7	8.0E-01	default[a]	0.0E+00	default[b]
Ethyl methacrylate	97-63-2	8.0E-01	default[a]	0.0E+00	default[b]
Ethyl-2-methyl benzene, 1-	611-14-3	9.7E-01	Bast and Borges, 1998	0.0E+00	default[b]

Attachment C:
Dermal and GI Absorption Factors

COC	CAS #	ABS.gi (unitless)	Reference	ABS.d (unitless)	Reference
Ethyl-4-methyl benzene, 1-	622-96-8	9.7E-01	Bast and Borges, 1998	0.0E+00	default[b]
Ethylenediamine	107-15-3	8.0E-01	default[a]	0.0E+00	default[b]
Ethylene dibromide	106-93-4	8.0E-01	default[a]	0.0E+00	default[b]
Ethylene glycol	107-21-1	5.0E-01	default[a]	1.0E-01	default[b]
Ethylene oxide	75-21-8	8.0E-01	default[a]	0.0E+00	default[b]
Ethylene thiourea	96-45-7	5.0E-01	default[a]	1.0E-01	default[b]
Fluoranthene	206-44-0	8.9E-01	Hecht, 1979	1.3E-01	Wester *et al*., 1990
Fluorene	86-73-7	8.9E-01	Hecht, 1979	1.3E-01	Wester *et al*., 1990
Fluorine (soluble fluoride)	7782-41-4	9.7E-01	Bast and Borges, 1998	1.0E-02	default[b]
Formaldehyde	50-00-0	8.0E-01	default[a]	0.0E+00	default[b]
Formic acid	64-18-6	8.0E-01	default[a]	0.0E+00	default[b]
Furan	110-00-9	8.0E-01	default[a]	0.0E+00	default[b]
Furfural	98-01-1	8.0E-01	default[a]	0.0E+00	default[b]
Glycidylaldehyde	765-34-4	8.0E-01	default[a]	0.0E+00	default[b]
Heptachlor	76-44-8	7.2E-01	Bast and Borges, 1998	1.0E-01	default[b]
Heptachlor epoxide	1024-57-3	7.2E-01	Bast and Borges, 1998	1.0E-01	default[b]
Hexachlorobenzene	118-74-1	5.0E-01	default[a]	1.0E-01	default[b]
Hexachlorobutadiene	87-68-3	5.0E-01	default[a]	1.0E-01	default[b]
Hexachlorocyclohexane, alpha	319-84-6	9.7E-01	Bast and Borges, 1998	1.0E-01	default[b]
Hexachlorocyclohexane, beta	319-85-7	9.1E-01	Bast and Borges, 1998	1.0E-01	default[b]
Hexachlorocyclohexane, gamma	58-89-9	9.7E-01	Bast and Borges, 1998	4.0E-02	Duff and Kissel, 1996
Hexachlorocyclohexane, techn	608-73-1	9.7E-01	Bast and Borges, 1998	1.0E-01	default[b]
Hexachlorocyclopentadiene	77-47-4	5.0E-01	default[a]	1.0E-01	default[b]

Attachment C:
Dermal and GI Absorption Factors

COC	CAS #	ABS.gi (unitless)	Reference	ABS.d (unitless)	Reference
Hexachloroethane	67-72-1	5.0E-01	default[a]	1.0E-01	default[b]
Hexachlorophene	70-30-4	5.0E-01	default[a]	1.0E-01	default[b]
Hexane, n-	110-54-3	8.0E-01	Bast and Borges, 1998	0.0E+00	default[b]
Hexazinone	51235-04-2	5.0E-01	default[a]	1.0E-01	default[b]
Hydrazine	302-01-2	8.0E-01	default[a]	0.0E+00	default[b]
Indeno-1,2,3-cd-pyrene	193-39-5	8.9E-01	Hecht, 1979	1.3E-01	Wester *et al*., 1990
Isobutyl alcohol	78-83-1	8.0E-01	default[a]	0.0E+00	default[b]
Isophorone	78-59-1	5.0E-01	default[a]	1.0E-01	default[b]
Kepone	143-50-0	5.0E-01	default[a]	1.0E-01	default[b]
Malathion	121-75-5	5.0E-01	default[a]	1.0E-01	default[b]
Maleic anhydride	108-31-6	5.0E-01	default[a]	1.0E-01	default[b]
Maleic hydrazide	123-33-1	5.0E-01	default[a]	1.0E-01	default[b]
Malononitrile	109-77-3	5.0E-01	default[a]	1.0E-01	default[b]
Manganese	7439-96-5	6.0E-02	Ruoff, 1995	1.0E-02	default[b]
Mercury	7439-97-6	7.0E-02	IRIS, 1997	1.0E-02	default[b]
Methacrylonitrile	126-98-7	8.0E-01	default[a]	0.0E+00	default[b]
Methanol	67-56-1	8.0E-01	default[a]	0.0E+00	default[b]
Methomyl	16752-77-5	5.0E-01	default[a]	1.0E-01	default[b]
Methoxychlor	72-43-5	5.0E-01	default[a]	1.0E-01	default[b]
Methoxyethanol, 2-	109-86-4	8.0E-01	default[a]	0.0E+00	default[b]
Methyl ethyl ketone	78-93-3	8.0E-01	Bast and Borges, 1998	0.0E+00	default[b]
Methyl isobutyl ketone	108-10-1	8.0E-01	Bast and Borges, 1998	0.0E+00	default[b]
Methyl mercury	22967-92-6	9.0E-01	Bast and Borges, 1998	1.0E-02	default[b]

Attachment C: Dermal and GI Absorption Factors					
COC	**CAS #**	**ABS.gi (unitless)**	**Reference**	**ABS.d (unitless)**	**Reference**
Methyl methacrylate	80-62-6	8.0E-01	default[a]	0.0E+00	default[b]
Methylnaphthalene, 2-	91-57-6	8.9E-01	Hecht, 1979	1.3E-01	Wester *et al*., 1990
Methyl parathion	298-00-0	5.0E-01	default[a]	1.0E-01	default[b]
Methylene-bis (2-chloroaniline) 4,4'-	101-14-4	5.0E-01	default[a]	1.0E-01	default[b]
Methylene chloride	75-09-2	9.5E-01	Bast and Borges, 1998	0.0E+00	default[b]
Molinate	2212-67-1	5.0E-01	default[a]	1.0E-01	default[b]
Molybdenum	7439-98-7	3.8E-01	Bast and Borges, 1998	1.0E-02	default[b]
Naled	300-76-5	5.0E-01	default[a]	1.0E-01	default[b]
Naphthalene	91-20-3	8.9E-01	Hecht, 1979	1.3E-01	Wester *et al*., 1990
Nickel and compounds (soluble salts)	7440-02-0	4.0E-02	Elakhovskay, 1972	1.0E-02	default[b]
Nitrate	14797-55-8	5.0E-01	Bast and Borges, 1998	1.0E-02	default[b]
Nitrite	14797-65-0	5.0E-01	Bast and Borges, 1998	1.0E-02	default[b]
Nitroaniline, 2-	88-74-4	5.0E-01	default[a]	1.0E-01	default[b]
Nitrobenzene	98-95-3	9.7E-01	Bast and Borges, 1998	1.0E-01	default[b]
Nitropropane, 2-	79-46-9	8.0E-01	default[a]	0.0E+00	default[b]
Nitroso-n-ethylurea, n-	759-73-9	5.0E-01	default[a]	1.0E-01	default[b]
Nitroso-methyl-ethyl-amine, n-	10595-95-6	8.0E-01	default[a]	0.0E+00	default[b]
Nitrosodi-n-butylamine, n-	924-16-3	5.0E-01	default[a]	1.0E-01	default[b]
Nitrosodi-n-propylamine, n-	621-64-7	2.5E-01	Bast and Borges, 1998	1.0E-01	default[b]
Nitrosodiethanolamine	1116-54-7	5.0E-01	default[a]	1.0E-01	default[b]
Nitrosodiethylamine, n-	55-18-5	8.0E-01	default[a]	0.0E+00	default[b]
Nitrosodimethylamine, n-	62-75-9	8.0E-01	default[a]	0.0E+00	default[b]
Nitrosodiphenylamine	86-30-6	2.5E-01	Bast and Borges, 1998	1.0E-01	default[b]

Attachment C: Dermal and GI Absorption Factors					
COC	**CAS #**	**ABS.gi (unitless)**	**Reference**	**ABS.d (unitless)**	**Reference**
Nitrosopyrrolidine, n-	930-55-2	5.0E-01	default[a]	1.0E-01	default[b]
Nitrotoluene, m-	99-08-1	5.0E-01	default[a]	1.0E-01	default[b]
Nitrotoluene, o-	88-72-2	5.0E-01	default[a]	1.0E-01	default[b]
Nitrotoluene, p-	99-99-0	5.0E-01	default[a]	1.0E-01	default[b]
Octamethylpyrophosphoramide	152-16-9	5.0E-01	default[a]	1.0E-01	default[b]
Oxamyl	23135-22-0	5.0E-01	default[a]	1.0E-01	default[b]
Parathion	56-38-2	5.0E-01	default[a]	1.0E-01	default[b]
Pebulate	1114-71-2	5.0E-01	default[a]	1.0E-01	default[b]
Pentachlorobenzene	608-93-5	5.0E-01	default[a]	1.0E-01	default[b]
Pentachloronitrobenzene	82-68-8	5.0E-01	default[a]	1.0E-01	default[b]
Pentachlorophenol	87-86-5	7.6E-01	Korte, 1978	2.5E-01	Wester *et al*., 1993b
Phenanthrene	85-01-8	8.9E-01	Hecht, 1979	1.3E-01	Wester *et al*., 1990
Phenol	108-95-2	9.0E-01	Bast and Borges, 1998	1.0E-01	default[b]
Phenyl mercuric acetate	62-38-4	5.0E-01	default[a]	1.0E-01	default[b]
Phenylene diamine, m-	108-45-2	5.0E-01	default[a]	1.0E-01	default[b]
Phenylene diamine, p-	106-50-3	5.0E-01	default[a]	1.0E-01	default[b]
Phorate	298-02-2	5.0E-01	default[a]	1.0E-01	default[b]
Phosphine	7803-51-2	2.0E-01	default[a]	1.0E-02	default[b]
Phosphorus, white	7723-14-0	2.0E-01	default[a]	1.0E-02	default[b]
Phthalic anhydride	85-44-9	5.0E-01	default[a]	1.0E-01	default[b]
Polybrominated biphenyls	67774-32-7	9.3E-01	Bast and Borges, 1998	1.0E-01	default[b]
Pronamide	23950-58-5	5.0E-01	default[a]	1.0E-01	default[b]
Propargite	2312-35-8	5.0E-01	default[a]	1.0E-01	default[b]

Attachment C: Dermal and GI Absorption Factors					
COC	**CAS #**	**ABS.gi (unitless)**	**Reference**	**ABS.d (unitless)**	**Reference**
Propargyl alcohol	107-19-7	8.0E-01	default[a]	0.0E+00	default[b]
Propham	122-42-9	5.0E-01	default[a]	1.0E-01	default[b]
Propylene oxide	75-56-9	8.0E-01	default[a]	0.0E+00	default[b]
Pyrene	129-00-0	8.9E-01	Hecht, 1979	1.3E-01	Wester *et al*., 1990
Pyridine	110-86-1	8.0E-01	default[a]	0.0E+00	default[b]
Quinoline	91-22-5	5.0E-01	default[a]	1.0E-01	default[b]
Selenium	7782-49-2	>5.0E-01	Young, 1982	1.0E-02	default[b]
Selenourea	630-10-4	---	---	---	default[b]
Silver	7440-22-4	4.0E-02	IRIS, 1998	1.0E-02	default[b]
Sodium diethyldithiocarbamate	148-18-5	---	---	---	default[b]
Strychnine	57-24-9	5.0E-01	default[a]	1.0E-01	default[b]
Styrene	100-42-5	8.0E-01	default[a]	0.0E+00	default[b]
Tetrachlorobenzene, 1,2,4,5-	95-94-3	5.0E-01	default[a]	1.0E-01	default[b]
Tetrachloroethane, 1,1,1,2-	630-20-6	8.0E-01	default[a]	0.0E+00	default[b]
Tetrachloroethane, 1,1,2,2-	79-34-5	7.0E-01	Bast and Borges, 1998	0.0E+00	default[b]
Tetrachloroethylene	127-18-4	1.0E+00	Bast and Borges, 1998	0.0E+00	default[b]
Tetrachlorophenol, 2,3,4,6-	58-90-2	5.0E-01	default[a]	1.0E-01	default[b]
Tetraethyl dithiopyrophosphate	3689-24-5	5.0E-01	default[a]	1.0E-01	default[b]
Tetraethyl lead	78-00-2	5.0E-01	default[a]	1.0E-01	default[b]
Thallium and compounds (as thallium chloride)	7791-12-0	1.0E+00	Lie, 1960	1.0E-02	default[b]
Thiofanox	39196-18-4	5.0E-01	default[a]	1.0E-01	default[b]
Thiophanate-methyl	23564-05-8	5.0E-01	default[a]	1.0E-01	default[b]

Attachment C:
Dermal and GI Absorption Factors

COC	CAS #	ABS.gi (unitless)	Reference	ABS.d (unitless)	Reference
Thiram	137-26-8	5.0E-01	default[a]	1.0E-01	default[b]
Tin	7440-31-5	1.0E-01	Bast and Borges, 1998	1.0E-02	default[b]
Toluene	108-88-3	8.0E-01	Bast and Borges, 1998	0.0E+00	default[b]
Toluenediamine, 2,4-	95-80-7	5.0E-01	default[a]	1.0E-01	default[b]
Toluenediamine, 2,6-	823-40-5	5.0E-01	default[a]	1.0E-01	default[b]
Toluene diisocyanate, 2,4/2,6-	26471-62-5	5.0E-01	default[a]	1.0E-01	default[b]
Toluidine, p-	106-49-0	5.0E-01	default[a]	1.0E-01	default[b]
Toxaphene	8001-35-2	5.0E-01	default[a]	1.0E-01	default[b]
TP Silvex, 2,4,5-	93-72-1	5.0E-01	default[a]	1.0E-01	default[b]
Triallate	2303-17-5	5.0E-01	default[a]	1.0E-01	default[b]
Tributyltin oxide	56-35-9	5.0E-01	default[a]	1.0E-01	default[b]
Trichloro-1,2,2-trifluoroethane, 1,1,2-	76-13-1	8.0E-01	default[a]	0.0E+00	default[b]
Trichlorobenzene, 1,2,4-	120-82-1	9.7E-01	Bast and Borges, 1998	1.0E-01	default[b]
Trichloroethane, 1,1,1-	71-55-6	9.0E-01	Bast and Borges, 1998	0.0E+00	default[b]
Trichloroethane, 1,1,2-	79-00-5	8.1E-01	Bast and Borges, 1998	0.0E+00	default[b]
Trichloroethylene	79-01-6	1.5E-01	Bast and Borges, 1998	0.0E+00	default[b]
Trichlorofluoromethane	75-69-4	2.3E-01	Bast and Borges, 1998	0.0E+00	default[b]
Trichlorophenol, 2,4,5-	95-95-4	5.0E-01	default[a]	1.0E-01	default[b]
Trichlorophenol, 2,4,6-	88-06-2	5.0E-01	default[a]	1.0E-01	default[b]
Trichlorophenoxyacetic acid, 2,4,5-	93-76-5	5.0E-01	default[a]	1.0E-01	default[b]
Trichloropropane, 1,1,2-	598-77-6	8.0E-01	default[a]	0.0E+00	default[b]
Trichloropropane, 1,2,3-	96-18-4	8.0E-01	default[a]	0.0E+00	default[b]
Triethylamine	121-44-8	8.0E-01	default[a]	0.0E+00	default[b]

Attachment C: Dermal and GI Absorption Factors					
COC	CAS #	ABS.gi (unitless)	Reference	ABS.d (unitless)	Reference
Trifluralin	1582-09-8	5.0E-01	default[a]	1.0E-01	default[b]
Trimethylbenzene, 1,2,3-	526-73-8	9.7E-01	Bast and Borges, 1998	0.0E+00	default[b]
Trinitrobenzene, 1,3,5-	99-35-4	6.5E-01	Bast and Borges, 1998	1.0E-01	default[b]
Trinitrophenylmethylnitramine	479-45-8	5.0E-01	Bast and Borges, 1998	1.0E-01	default[b]
Trinitrotoluene, 2,4,6-	118-96-7	6.0E-01	Bast and Borges, 1998	1.0E-01	default[b]
Uranium	7440-61-1	8.5E-01	Bast and Borges, 1998	1.0E-02	default[b]
Vanadium	7440-62-2	2.6E-02	Conklin, 1982	1.0E-02	default[b]
Vernam	1929-77-7	5.0E-01	default[a]	1.0E-01	default[b]
Vinyl acetate	108-05-4	6.5E-01	Bast and Borges, 1998	0.0E+00	default[b]
Vinyl chloride	75-01-4	1.0E+00	Bast and Borges, 1998	0.0E+00	default[b]
Warfarin	81-81-2	5.0E-01	default[a]	1.0E-01	default[b]
Xylene, m-	108-38-3	8.0E-01	default[a]	0.0E+00	default[b]
Xylene, o-	95-47-6	8.0E-01	default[a]	0.0E+00	default[b]
Xylene, p-	106-42-3	8.0E-01	default[a]	0.0E+00	default[b]
Xylenes	1330-20-7	9.2E-01	Bast and Borges, 1998	0.0E+00	default[b]
Zinc	7440-66-6	2.0E-01	Bast and Borges, 1998	1.0E-02	default[b]

a: 80% for volatile organics; 50% for semi-volatile organics and non-volatile organics; 20% for inorganics. USEPA, 1995, *Supplemental Guidance to RAGS: Region IV Bulletins, Human Health Assessment*, Waste Management Division, Atlanta, GA, November.

b: 0% for volatile organics; 10% for semi-volatile organics and non-volatile organics; 1% for inorganics. USEPA Dermal Workgroup, 1996.

Attachment D:
Equations for Calculating Soil Medium Specific Concentrations (MSCs)

Note: For the inhalation pathway, the VF component is not considered (e.g., 1/VF = 0) for contaminants with a Henry's Law Constant < 1e-05 atm/m^3/mole.

For contaminants with an ABS.d value of zero (0), the dermal pathway is not applicable.

MSC EQUATIONS UNDER RISK REDUCTION STANDARD NUMBER 2

Residential Scenario

Inhalation and Ingestion of *carcinogenic* contaminants in soil (mg/kg)

$$MSC_{Inhalation\ +\ Ingestion} = \frac{RL\ x\ BW\ x\ ATc\ x\ 365\ days/yr}{EF\ x\ [(BW\ x\ SFo\ x\ 10^{-6}\ kg/mg\ x\ IFadj)\ +\ (SFi\ x\ ED\ x\ IRair\ x\ (1/VF\ +\ 1/PEF))]}$$

Dermal contact with *carcinogenic* contaminants in soil (mg/kg)

$$MSC_{Dermal} = \frac{RL\ x\ ATc\ x\ 365\ days/yr}{SFd\ 10^{-6}\ kg/mg\ x\ EF\ x\ DF.adj\ x\ ABS.d}$$

Inhalation and Ingestion of *noncarcinogenic* contaminants in soil (mg/kg)

$$MSC_{Inhalation\ +\ Ingestion} = \frac{HQ\ x\ BW\ x\ AT\ x\ 365\ days/yr}{EF\ [(1/RfDo\ x\ BW\ x\ 10^{-6}\ kg/mg\ x\ IFadj)\ +\ (1/RfDi\ x\ ED\ x\ IRair\ x\ (1/VF\ +\ 1/PEF))]}$$

Dermal contact with *noncarcinogenic* contaminants in soil (mg/kg)

$$MSC_{Dermal} = \frac{HQ\ x\ RfD.d\ x\ BW\ x\ AT\ x\ 365\ days/yr}{10^{-6}\ kg/mg\ x\ ED\ x\ EF\ x\ SA\ x\ AF\ x\ ABS.d}$$

Dermal contact with *Cadmium* in soil (age-adjusted noncarcinogenic equation; mg/kg)

$$MSC_{Dermal} = \frac{HQ\ x\ RfD.d\ x\ AT.AgeAdj\ x\ 365\ days/yr}{10^{-6}\ kg/mg\ x\ EF\ x\ DF.adj\ x\ ABS.d}$$

Commercial/Industrial Scenario

Inhalation and Ingestion of *carcinogenic* contaminants in soil (mg/kg)

$$MSC_{Inhalation\ +\ Ingestion} = \frac{RL\ x\ BW\ x\ AT\ x\ 365\ days/yr}{ED\ x\ EF\ x\ [(SFo\ x\ 10^{-6}\ kg/mg\ x\ IRsoil)\ +\ (SFi\ x\ IRair\ x\ (1/VF\ +\ 1/PEF))]}$$

Dermal contact with *carcinogenic* contaminants in soil (mg/kg)

$$MSC_{Dermal} = \frac{RL\ x\ BW\ x\ ATc\ x\ 365\ days/yr}{SFd\ x\ 10^{-6}\ kg/mg\ x\ ED\ x\ EF\ x\ SA\ x\ AF\ x\ ABS.d}$$

Inhalation and Ingestion of *noncarcinogenic* contaminants in soil (mg/kg)

$$MSC_{Inhalation\ +\ Ingestion} = \frac{HQ\ x\ BW\ x\ AT\ x\ 365\ days/yr}{ED\ x\ EF\ x\ [(1/RfDo\ x\ 10^{-6}\ kg/mg\ x\ IRsoil)\ +\ (1/RfDi\ x\ IRair\ x\ (1/VF\ +\ 1/PEF))]}$$

Dermal contact with *noncarcinogenic* contaminants in soil (mg/kg)

$$MSC_{Dermal} = \frac{HQ\ x\ RfD.d\ x\ BW\ x\ AT\ x\ 365\ days/yr}{10^{-6}\ kg/mg\ x\ ED\ x\ EF\ x\ SA\ x\ AF\ x\ ABS.d}$$

MSC EQUATIONS UNDER RISK REDUCTION STANDARD NUMBER 3

Please note, in calculating risk and hazard as a part of the Baseline Risk Assessment required under Standard 3, the equations provided below should be rearranged to solve for the risk (RL) and hazard (HQ) components of each of the equations. The risk and/or hazard for each individual contaminant should then be determined by combining the risks and hazards associated with each of the pathways (i.e., inhalation + ingestion + dermal contact). Please note that for the inhalation pathways, unit risk factors (URFs) and reference concentrations (RfCs) are used in lieu of the inhalation slope factors (SFis) and reference doses (RfDis) used for Standard 2.

Residential Scenario

Inhalation of *carcinogenic* contaminants in soil (mg/kg)

$$MSC_{Inhalation} = \frac{RL\ x\ ATc\ x\ 365\ days/yr}{URF\ x\ 1000\ \mu g/mg\ x\ ED\ x\ EF\ x\ (1/VF\ +\ 1/PEF)}$$

Ingestion of *carcinogenic* contaminants in soil (mg/kg)

$$MSC_{Ingestion} = \frac{RL\ x\ ATc\ x\ 365\ days/yr}{SFo\ x\ 10^{-6}\ kg/mg\ x\ EF\ x\ IFadj}$$

Dermal contact with *carcinogenic* contaminants in soil (mg/kg)

$$MSC_{Dermal} = \frac{RL \times ATc \times 365\ days/yr}{SFd \times 10^{-6}\ kg/mg \times EF \times DF.adj \times ABS.d}$$

Inhalation of *noncarcinogenic* contaminants in soil (mg/kg)

$$MSC_{Inhalation} = \frac{HQ \times RfC \times AT \times 365\ days/yr}{ED \times EF \times (1/VF + 1/PEF)}$$

Ingestion of *noncarcinogenic* contaminants in soil (mg/kg)

$$MSC_{Ingestion} = \frac{HQ \times RfDo \times AT \times 365\ days/yr}{10^{-6}\ kg/mg \times EF \times IFadj}$$

Dermal contact with *noncarcinogenic* contaminants in soil (mg/kg)

$$MSC_{Dermal} = \frac{HQ \times RfD.d \times BW \times AT \times 365\ days/yr}{10^{-6}\ kg/mg \times ED \times EF \times SA \times AF \times ABS.d}$$

Dermal contact with *Cadmium* in soil (age-adjusted noncarcinogenic equation; mg/kg)

$$MSC_{Dermal} = \frac{HQ \times RfD.d \times AT.AgeAdj \times 365\ days/yr}{10^{-6}\ kg/mg \times EF \times DF.adj \times ABS.d}$$

Commercial/Industrial and Trespasser Scenarios

Inhalation of *carcinogenic* contaminants in soil (mg/kg)

$$MSC_{Inhalation} = \frac{RL \times ATc \times 365\ days/yr}{URF \times 1000\ \mu g/mg \times ED \times EF \times (1/VF + 1/PEF)}$$

Ingestion of *carcinogenic* contaminants in soil (mg/kg)

$$MSC_{Ingestion} = \frac{RL \times BW \times ATc \times 365\ days/yr}{SFo \times 10^{-6}\ kg/mg \times ED \times EF \times IRsoil}$$

Dermal contact with *carcinogenic* contaminants in soil (mg/kg)

$$MSC_{Dermal} = \frac{RL \times BW \times ATc \times 365\ days/yr}{SFd \times 10^{-6}\ kg/mg \times ED \times EF \times SA \times AF \times ABS.d}$$

Inhalation of *noncarcinogenic* contaminants in soil (mg/kg)

$$MSC_{Inhalation} = \frac{HQ \times RfC \times AT \times 365\ days/yr}{ED \times EF \times (1/VF + 1/PEF)}$$

Ingestion of *noncarcinogenic* contaminants in soil (mg/kg)

$$MSC_{Ingestion} = \frac{HQ \times BW \times RfDo \times AT \times 365\ days/yr}{10^{-6}\ kg/mg \times ED \times EF \times IRsoil}$$

Dermal contact with *noncarcinogenic* contaminants in soil (mg/kg)

$$MSC_{Dermal} = \frac{HQ \times RfD.d \times BW \times AT \times 365\ days/yr}{10^{-6}\ kg/mg \times ED \times EF \times SA \times AF \times ABS.d}$$

Table D1:
Default Exposure Factors For Use in Soil MSC Equations

Term	Definition	Scenario or Pathway	Default Value
ABS.d	Dermal Absorption Fraction (unitless)	All scenarios; dermal	Chemical-Specific (see Attachment C)
AF	Soil-to-Skin Adherence Factor, (mg/cm^2-event)	Residential, commercial/industrial, dermal	0.2
		Trespasser; dermal	0.1
AT	Averaging Time (yr)	Residential, inhalation, ingestion, adult (noncarcinogens)	33
		Residential, dermal, child (noncarcinogens)	6
		Commercial/industrial, all pathways (noncarcinogens)	25
		Trespasser, all pathways (noncarcinogens)	12
AT.AgeAdj	Averaging Time, age-adjusted	Residential, dermal (for cadmium)	33
ATc	Averaging Time - carcinogens (yr)	All scenarios, all pathways (carcinogens)	70
BW	Body Weight (kg)	Residential, all applicable pathways except dermal, adult; Commercial/industrial, trespasser; all applicable pathways	70
		Residential, dermal, child (noncarcinogens)	15
DF.adj	Age-adjusted dermal factor (mg-yr/kg-event)	Residential, dermal (carcinogens)	300
ED	Exposure Duration (yr)	Residential, RRS 2 - inhalation + ingestion, adult; Residential, RRS 3 - inhalation, ingestion, adult	33
		Residential, dermal, child (noncarcinogens)	6
		Commercial/industrial, all pathways	25
		Trespasser, all pathways	12

Table D1:
Default Exposure Factors For Use in Soil MSC Equations

Term	Definition	Scenario or Pathway	Default Value
EF	Exposure Frequency, (days/yr; event/yr for dermal);	Residential, all pathways	350
		Commercial/industrial, all pathways	250
		Trespasser, all pathways	50
HQ	Hazard Quotient (unitless)	All scenarios, all pathways (noncarcinogens)	1
IFadj	Age-adjusted soil ingestion factor (mg-yr/kg-day)	Residential, ingestion	114
IRair	Daily indoor inhalation rate (m^3/day)	All scenarios, inhalation, RRS2	20
IRsoil	Soil ingestion rate (mg/day)	Commerical/industrial, ingestion	50
		Trespasser, ingestion	100
PEF	Particulate emission factor (m^3/kg)	All scenarios, inhalation	4.63×10^9
RfD.d	Dermal Reference Dose (mg/kg-day)	All scenarios, dermal (noncarcinogens)	Calculated: Chemical-Specific
RfDi	Inhalation Reference Dose (mg/kg-day)	All scenarios, inhalation (noncarcinogens)	Chemical-Specific
RfDo	Oral Reference Dose (mg/kg-day)	All scenarios, ingestion (noncarcinogens)	Chemical-Specific
RL	Risk Level (unitless)	All scenarios, all pathways (carcinogens)	10^{-6} for Class A and B carcinogens; 10^{-5} for Class C carcinogens
SA	Skin Surface Area (cm^2)	Residential, dermal, child	2200
		Commerical/industrial, dermal	2500

Table D1:
Default Exposure Factors For Use in Soil MSC Equations

Term	Definition	Scenario or Pathway	Default Value
		Trespasser, dermal	3500
SFd	Dermal Slope Factor (mg/kg-day)$^{-1}$	All scenarios, dermal (carcinogens)	Calculated: Chemical-Specific
SFi	Inhalation Slope Factor (mg/kg-day)$^{-1}$	All scenarios, inhalation, RRS2 (carcinogens)	Chemical-Specific
SFo	Oral Slope Factor (mg/kg-day)$^{-1}$	All scenarios, ingestion (carcinogens)	Calculated: Chemical-Specific
URF	Reference Concentration (mg/m^3)	All scenarios, inhalation, RRS3 (noncarcinogens)	Chemical-Specific
VF	Soil-to-air volatilization factor (m^3/kg)	All scenarios, inhalation	Calculated: Chemical-Specific

Attachment E:
Chemical/Physical Properties

Chemical of Concern	CAS	Type	MW *(g/mole)*	H '*(unitless)*	K_{ow} *(unitless)*	K_d *(unitless)*	D_{air} *(cm^2/s)*	D_{wat} *(cm^2/s)*	Solubility *(mg/l)*	Vapor Pressure *(mm Hg)*
Acenaphthene	83-32-9	O	154.21	6.44E-03	1.42E+04	7.96E+00	4.21E-02	7.69E-06	4.24E+00	3.75E-03
Acenaphthylene	208-96-8	O	152.20	4.74E-03	8.63E+03	1.38E+01	4.39E-02	7.07E-06	3.93E+00	2.90E-02
Acetaldehyde	75-07-0	O	44.05	2.75E-03	2.69E+00	5.25E-03	1.24E-01	1.23E-05	1.00E+06	9.00E+02
Acetone	67-64-1	O	58.08	1.61E-03	5.82E-01	1.14E-03	1.24E-01	1.14E-05	6.00E+05	2.27E+02
Acetone cyanohydrin	75-86-5	O	85.11	1.34E-04	9.24E-01	1.22E-03	8.12E-02	9.09E-06	1.83E+06	8.00E-01
Acetonitrile	75-05-8	O	41.05	1.21E-03	4.57E-01	9.35E-04	1.28E-01	1.45E-05	2.05E+05	9.00E+01
Acetophenone	98-86-2	O	120.15	4.45E-04	4.72E+01	7.26E-02	6.00E-02	8.73E-06	5.50E+03	3.95E-01
Acifluorfen, sodium	62476-59-9	O	383.64	8.31E-13	2.36E+00	2.26E-01	1.45E-02	4.40E-06	2.50E+05	9.75E-09
Acrolein	107-02-8	O	56.06	1.83E-04	7.94E-01	1.05E-03	1.05E-01	1.12E-05	2.00E+05	2.65E+02
Acrylamide	79-06-1	O	71.08	1.33E-08	1.56E-01	4.38E-04	9.70E-02	1.28E-05	2.20E+06	7.00E-03
Acrylic acid	79-10-7	O	72.06	1.32E-05	2.76E+00	2.27E-03	9.08E-02	1.06E-05	1.00E+06	3.72E+00
Acrylonitrile	107-13-1	O	53.06	4.57E-03	1.62E+00	2.19E-03	1.22E-01	1.34E-05	7.50E+04	1.10E+02
Alachlor	15972-60-8	O	269.77	8.62E-07	2.33E+03	3.80E-01	1.94E-02	5.83E-06	2.40E+02	2.20E-05
Aldicarb	116-06-3	O	190.27	5.82E-08	2.29E+01	3.16E-02	3.05E-02	7.20E-06	6.00E+03	2.90E-05
Aldicarb sulfone	1646-88-4	O	222.27	1.10E-07	2.16E-01	3.40E-03	5.55E-02	5.79E-06	8.00E+03	9.00E-05
Aldrin	309-00-2	O	364.91	7.07E-03	5.61E+06	9.57E+01	1.32E-02	4.86E-06	7.84E-02	1.67E-05
Allyl alcohol	107-18-6	O	58.08	2.08E-04	1.48E+00	6.47E-03	1.14E-01	1.10E-05	3.20E+05	2.63E+01
Allyl chloride	107-5-1	O	76.53	4.57E-01	8.56E+01	5.38E-02	9.80E-02	1.08E-05	3.40E+03	3.60E+02
Aluminum	7429-90-5	M	26.98	0.00E+00	2.13E+00	3.53E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Aminopyridine, 4-	504-24-5	O	94.12	2.44E-07	7.72E-01	9.52E-04	8.02E-02	1.08E-05	7.66E+04	2.00E-03
Ammonia	7664-41-7	I	17.03	1.36E-02	1.69E+00	6.18E-03	2.59E-01	6.93E-05	5.31E+05	7.47E+03
Aniline	62-53-3	O	93.13	5.82E-05	1.19E+01	1.82E-02	7.00E-02	8.30E-06	3.60E+04	6.69E-01
Anthracene	120-12-7	O	178.23	4.61E-03	2.21E+04	4.69E+01	3.24E-02	7.74E-06	4.34E-02	2.55E-05
Antimony	7440-36-0	M	121.75	0.00E+00	1.00E+00	4.50E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Aramite	140-57-8	O	334.86	CE	6.53E+04	1.98E+01	4.23E-02	4.45E-06	CE	1.23E-04
Arsenic	7440-38-2	M	74.92	0.00E+00	4.78E+00	2.50E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Arsine	7784-42-1	I	77.95	2.41E-01	---	---	CE	CE	2.00E+05	1.13E+04
Asbestos	1332-21-4	I	varies	0.00E+00	---	1.00E+05	CE	CE	0.00E+00	0.00E+00

Attachment E:
Chemical/Physical Properties

Chemical of Concern	CAS	Type	MW *(g/mole)*	H '*(unitless)*	K_{ow} *(unitless)*	K_d *(unitless)*	D_{air} *(cm^2/s)*	D_{wat} *(cm^2/s)*	Solubility *(mg/l)*	Vapor Pressure *(mm Hg)*
Atrazine	1912-24-9	O	215.69	1.09E-07	6.57E+02	3.20E-01	5.64E-02	5.58E-06	3.00E+01	3.00E-07
Barium	7440-39-3	M	137.33	0.00E+00	1.00E+00	1.10E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Benzene	71-43-2	O	78.11	2.27E-01	9.84E+01	1.32E-01	8.80E-02	9.80E-06	1.77E+03	9.50E+01
Benzenethiol	108-98-5	O	110.18	1.83E-02	4.85E+02	4.18E-02	7.60E-02	8.68E-06	7.60E+02	2.40E+00
Benzidine	92-87-5	O	184.24	1.62E-09	2.19E+01	4.18E-02	3.40E-02	1.50E-05	5.20E+02	8.36E-08
Benzo-a-anthracene	56-55-3	O	228.29	1.39E-04	3.32E+05	7.10E+02	5.10E-02	9.00E-06	1.00E-02	1.54E-07
Benzo-a-pyrene	50-32-8	O	252.32	4.70E-05	1.29E+06	1.91E+03	4.30E-02	9.00E-06	1.62E-03	4.89E-09
Benzo-b-fluoranthene	205-99-2	O	252.32	4.99E-04	1.29E+06	2.40E+03	2.26E-02	5.56E-06	1.50E-03	8.06E-08
Benzo-k-fluoranthene	207-08-9	O	252.32	4.45E-07	1.29E+06	2.46E+03	2.26E-02	5.56E-06	5.50E-04	9.59E-11
Benzo-(g,h,i)-perylene	191-24-2	O	276.34	5.82E-06	4.98E+06	3.17E+03	4.90E-02	5.65E-05	2.60E-04	1.00E-10
Benzoic acid	65-85-0	OA	122.12	1.39E-05	7.49E+01	1.00E-03	5.36E-02	7.97E-06	3.50E+03	6.51E-03
Benzotrichloride	98-07-7	O	195.48	2.03E-02	7.87E+03	2.91E+00	5.91E-02	7.02E-06	1.00E+02	1.90E-01
Benzyl alcohol	100-51-6	O	108.14	1.62E-05	1.19E+01	2.40E-02	8.00E-02	8.00E-06	4.00E+04	1.06E-01
Benzyl chloride	100-44-7	O	126.59	1.66E-02	6.23E+02	3.64E-01	7.50E-02	7.80E-06	4.93E+02	1.20E+00
Beryllium	7440-41-7	M	9.01	0.00E+00	3.72E+00	2.30E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Biphenyl, 1,1-	92-52-4	O	154.21	1.25E-02	5.71E+03	1.03E+01	5.73E-02	6.71E-06	7.50E+00	2.94E-02
Bis (2-chloro-ethyl) ether	111-44-4	O	143.01	8.90E-04	3.61E+01	3.10E-02	6.92E-02	7.53E-06	1.02E+04	1.34E+00
Bis (2-chloroisopropyl) ether	108-60-1	O	171.07	4.16E-03	3.80E+02	6.32E-01	6.00E-02	6.40E-06	1.70E+03	8.50E-01
Bis (2-chloromethyl) ether	542-88-1	O	114.96	4.99E-03	3.76E+00	2.40E-03	8.32E-02	9.59E-06	3.80E+04	3.00E+01
Bis (2-ethyl-hexyl) phthalate	117-81-7	O	390.56	4.57E-04	2.46E+08	1.36E+03	3.51E-02	3.66E-06	3.00E-01	6.45E-06
Bromodichloromethane	75-27-4	O	163.83	1.32E-01	4.08E+01	1.10E-01	2.98E-02	1.06E-05	4.50E+03	5.84E+01
Bromoform	75-25-2	O	252.73	2.56E-02	6.16E+01	1.74E-01	1.49E-02	1.03E-05	3.20E+03	5.60E+00
Bromomethane	74-83-9	O	94.94	5.90E-01	1.50E+01	2.09E-02	7.28E-02	1.21E-05	1.52E+04	1.64E+03
Butadiene, 1,3-	106-99-0	O	54.09	2.61E+00	1.08E+02	2.58E-01	1.79E-01	1.02E-05	7.35E+02	2.11E+03
Butanol, n-	71-36-3	O	74.12	3.55E-04	6.93E+00	1.18E-02	8.00E-02	9.30E-06	7.47E+04	6.54E+00
Butylate	2008-41-5	O	217.38	3.50E-03	7.13E+03	2.52E-01	4.89E-02	5.14E-06	4.60E+01	1.30E-02
Butyl benzyl phthalate	85-68-7	O	312.37	7.94E-05	6.99E+04	2.75E+01	1.74E-02	4.83E-06	2.90E+00	1.20E-05
Cacodylic acid	75-60-5	O	138.00	0.00E+00	1.00E+00	4.80E-03	CE	CE	2.00E+06	0.00E+00
Cadmium	7440-43-9	M	112.41	0.00E+00	8.49E-01	1.50E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Attachment E:
Chemical/Physical Properties

Chemical of Concern	CAS	Type	MW *(g/mole)*	H '*(unitless)*	K_{ow} *(unitless)*	K_d *(unitless)*	D_{air} *(cm^2/s)*	D_{wat} *(cm^2/s)*	Solubility *(mg/l)*	Vapor Pressure *(mm Hg)*
Captan	133-06-2	O	300.59	2.99E-04	6.98E+01	1.28E+01	1.83E-02	4.90E-06	5.00E-01	7.50E-06
Carbaryl	63-25-2	O	201.22	5.32E-07	2.23E+02	4.69E-01	2.78E-02	5.60E-06	3.00E+01	1.36E-06
Carbazole	86-74-8	O	167.21	3.38E-03	1.70E+03	4.91E+00	3.90E-02	7.03E-06	7.21E-01	2.66E-04
Carbofuran	1563-66-2	O	221.26	1.62E-07	2.00E+02	5.80E-02	5.35E-02	5.40E-06	7.00E+02	8.30E-06
Carbon disulfide	75-15-0	O	76.14	6.13E-01	8.71E+01	1.05E-01	1.04E-01	1.00E-05	2.30E+03	3.40E+02
Carbon tetrachloride	56-23-5	O	153.82	1.20E+00	2.77E+02	3.72E-01	7.80E-02	8.80E-06	8.05E+02	1.12E+02
Carbosulfan	55285-14-8	O	380.55	2.15E-05	3.73E+05	5.14E+01	3.76E-02	3.88E-06	3.00E-01	3.10E-07
Chloral	75-87-6	O	147.39	2.66E-05	1.55E+01	1.27E-02	3.85E-02	9.70E-06	8.30E+06	3.50E+01
Chlordane	57-74-9	O	409.78	2.02E-03	4.00E+06	2.40E+02	1.18E-02	4.37E-06	5.60E-02	1.00E-05
Chlorine	7782-50-5	I	70.91	2.86E+00	7.07E+00	---	1.20E-01	1.48E-05	7.00E+03	5.17E+03
Chloroanaline, p-	106-47-8	O	127.57	4.86E-05	5.25E+01	1.32E-01	4.83E-02	1.01E-05	3.90E+03	2.35E-02
Chlorobenzene	108-90-7	O	112.56	1.82E-01	4.34E+02	4.28E-01	7.30E-02	8.70E-06	5.02E+02	1.21E+01
Chlorobenzilate	510-15-6	O	325.19	3.78E-06	9.84E+03	1.60E+00	8.00E-02	8.00E-06	1.30E+01	2.20E-06
Chloro-1,3-butadiene, 2-	126-99-8	O	88.54	1.33E+00	3.35E+02	2.00E-01	1.00E-01	1.00E-05	6.30E+02	2.12E+02
Chlorodifluoromethane	75-45-6	O	86.47	1.22E+00	7.84E+00	1.22E-02	1.13E-01	1.32E-05	2.90E+03	7.83E+03
Chloroethane	75-00-3	O	64.51	2.12E-01	3.78E+01	3.56E-02	1.50E-01	1.18E-05	2.00E+04	1.20E+03
Chloroform	67-66-3	O	119.38	1.53E-01	3.32E+01	9.35E-02	1.04E-01	1.00E-05	7.92E+03	1.98E+02
Chloromethane	74-87-3	O	50.49	1.44E+00	1.22E+01	1.20E-02	1.26E-01	6.50E-06	7.25E+03	3.77E+03
Chloronaphthalene, 2-	91-58-7	O	162.62	2.54E-02	6.51E+03	1.70E+01	6.18E-02	6.98E-06	6.74E+00	1.70E-02
Chlorophenol, 2-	95-57-8	OA	128.56	7.40E-04	1.44E+02	5.72E-01	5.01E-02	9.46E-06	2.80E+04	1.42E+00
Chlorotoluene	25168-05-2	O	126.59	1.26E-02	6.23E+02	3.81E-01	7.13E-02	8.10E-06	5.00E+02	1.00E+00
Chlorpyrifos	2921-88-2	O	350.59	1.73E-04	4.55E+04	1.00E+01	4.85E-02	5.11E-06	9.00E-01	1.87E-05
Chromium (III)	16065-83-1	M	52.00	0.00E+00	1.00E+00	1.20E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Chromium (VI)	18540-29-9	M	52.00	0.00E+00	1.00E+00	1.40E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Chrysene	218-01-9	O	228.29	5.03E-05	3.32E+05	6.18E+02	2.48E-02	6.21E-06	2.00E-03	7.80E-09
Cobalt	7440-48-4	M	58.93	0.00E+00	1.00E+00	4.50E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Copper	7440-50-8	M	63.55	0.00E+00	2.69E-01	4.00E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cresol, m-	108-39-4	O	108.14	3.62E-05	1.15E+02	1.74E-01	7.40E-02	1.00E-05	2.30E+04	1.40E-01
Cresol, o-	95-48-7	O	108.14	6.65E-05	1.15E+02	1.95E-01	7.40E-02	8.30E-06	2.04E+04	3.20E-01

Attachment E:
Chemical/Physical Properties

Chemical of Concern	CAS	Type	MW *(g/mole)*	H '*(unitless)*	K_{ow} *(unitless)*	K_d *(unitless)*	D_{air} *(cm^2/s)*	D_{wat} *(cm^2/s)*	Solubility *(mg/l)*	Vapor Pressure *(mm Hg)*
Cresol, p-	106-44-5	O	108.14	3.99E-05	1.15E+02	1.63E-01	7.40E-02	1.00E-05	2.30E+04	1.30E-01
Crotonaldehyde	123-73-9	O	70.09	8.15E-04	3.99E+00	3.27E-03	9.37E-02	1.02E-05	1.60E+05	1.90E+01
Cumene	98-82-8	O	120.19	6.07E-01	2.81E+03	6.93E+00	6.50E-02	7.10E-06	5.00E+01	4.60E+00
Cyanide	57-12-5	I	26.02	CE	2.03E-01	9.90E+00	5.21E-01	2.28E-05	1.00E+05	1.38E+01
Cyanogen	460-19-5	O	52.04	2.06E-01	1.17E+00	2.72E-03	2.04E-01	1.37E-05	1.00E+04	3.88E+03
Cyclohexanone	108-94-1	O	98.14	4.99E-04	1.34E+01	1.10E-02	7.72E-02	8.73E-06	2.30E+04	4.00E+00
Cyclotrimethylenetrinitramine	121-82-4	O	222.12	4.99E-04	7.41E+00	1.26E-01	6.65E-02	6.39E-06	3.87E+01	1.00E-09
DDD	72-54-8	O	320.05	1.66E-04	7.47E+05	1.70E+02	1.69E-02	4.76E-06	9.00E-02	8.66E-07
DDE	72-55-9	O	241.93	8.73E-04	9.90E+05	2.19E+02	1.44E-02	5.87E-06	6.50E-02	5.66E-06
DDT	50-29-3	O	354.49	2.23E-03	6.23E+06	2.75E+02	1.37E-02	4.95E-06	3.10E-03	3.93E-07
Di-n-butyl phthalate	84-74-2	O	278.35	5.94E-05	4.07E+04	6.78E+01	4.38E-02	7.86E-06	1.12E+01	4.25E-05
Di-n-octyl phthalate	117-84-0	O	390.56	2.78E-03	3.46E+08	1.66E+05	1.51E-02	3.90E-06	2.00E-02	4.47E-06
Diallate	2303-16-4	O	270.22	1.58E-04	1.19E+04	3.80E+00	8.00E-02	8.00E-06	1.40E+01	1.50E-04
Diazinon	333-41-5	O	304.35	4.70E-06	7.31E+03	2.64E-01	1.80E-02	4.90E-06	4.00E+01	8.40E-05
Dibenz-a,h-anthracene	53-70-3	O	278.35	4.66E-07	4.98E+06	3.81E+03	2.00E-02	5.18E-06	5.00E-04	2.10E-11
Dibromo-3-chloropropane, 1,2-	96-12-8	O	236.33	8.31E-03	4.81E+02	3.40E-01	8.00E-02	8.00E-06	1.00E+03	7.60E-01
Dibromochloromethane	124-48-1	O	208.28	3.25E-02	5.01E+01	1.26E-01	1.96E-02	1.05E-05	5.25E+03	1.50E+01
Dicamba	1918-00-9	O	209.03	3.28E-07	1.39E+02	4.40E-03	6.02E-02	6.69E-06	5.60E+03	9.70E-05
Dichlorobenzene, 1,2-	95-50-1	O	147.00	8.73E-02	1.91E+03	1.38E+00	6.90E-02	7.90E-06	1.50E+02	1.36E+00
Dichlorobenzene, 1,4-	106-46-7	O	147.00	1.17E-01	1.91E+03	1.29E+00	6.90E-02	7.90E-06	7.38E+01	1.06E+00
Dichlorobenzidine, 3,3-	91-94-1	O	253.13	8.65E-07	1.63E+03	1.45E+00	1.94E-02	6.74E-06	3.11E+00	2.20E-07
Dichloro-2-butene, 1,4	764-41-0	O	125.00	1.24E-02	3.97E+02	3.64E-01	7.43E-02	8.62E-06	6.91E+03	1.26E+01
Dichlorodifluoromethane	75-71-8	O	120.91	1.67E+01	6.54E+01	2.58E-01	5.20E-02	1.05E-05	2.80E+02	4.80E+03
Dichloroethane, 1,1-	75-34-3	O	98.96	2.39E-01	5.73E+01	6.32E-02	7.42E-02	1.05E-05	5.50E+03	2.28E+02
Dichloroethane, 1,2-	107-06-2	O	98.96	5.32E-02	6.79E+01	3.48E-02	1.04E-01	9.90E-06	8.70E+03	8.13E+01
Dichloroethylene, 1,1-	75-35-4	O	96.94	1.06E+00	1.30E+02	1.29E-01	9.00E-02	1.04E-05	2.40E+03	5.91E+02
Dichloroethylene, cis-1,2-	156-59-2	O	96.94	1.87E-01	7.24E+01	5.80E-02	7.35E-02	1.13E-05	4.93E+03	1.75E+02
Dichloroethylene, trans-1,2	156-60-5	O	96.94	3.90E-01	1.17E+02	1.00E-01	7.07E-02	1.19E-05	6.30E+03	3.52E+02
Dichlorophenol, 2,4-	120-83-2	OA	163.00	1.31E-04	6.34E+02	1.44E-01	3.46E-02	8.77E-06	4.50E+03	7.15E-02

Attachment E:
Chemical/Physical Properties

Chemical of Concern	CAS	Type	MW *(g/mole)*	H '*(unitless)*	K_{ow} *(unitless)*	K_d *(unitless)*	D_{air} *(cm^2/s)*	D_{wat} *(cm^2/s)*	Solubility *(mg/l)*	Vapor Pressure *(mm Hg)*
Dichlorophenoxyacetic acid, 2,4-	94-75-7	O	221.04	5.82E-09	4.14E+02	1.78E+00	5.90E-02	6.50E-06	8.90E+02	2.40E-05
Dichloropropane, 1,2	78-87-5	O	112.99	1.17E-01	1.78E+02	1.18E-01	7.82E-02	8.73E-06	2.80E+03	5.00E+01
Dichloro-1-propanol, 2,3-	616-23-9	O	128.99	3.97E-05	6.09E+00	6.78E-02	4.84E-02	9.84E-06	2.95E+05	5.82E-01
Dichloropropene, 1,3-	542-75-6	O	110.97	1.23E-01	5.62E+01	1.05E-01	6.26E-02	1.00E-05	1.55E+03	3.12E+01
Dichlorvos	62-73-7	O	220.98	3.98E-05	2.51E+01	7.78E+06	2.32E-02	7.80E-06	1.60E+04	5.27E-02
Dieldrin	60-57-1	O	380.91	1.11E-04	2.80E+05	4.28E+01	1.25E-02	4.74E-06	1.95E-01	9.96E-07
Diethylhexyl adipate	103-23-1	O	370.57	9.78E-01	1.30E+08	7.60E+02	3.56E-02	3.72E-06	1.71E-03	8.25E-05
Diethyl phthalate	84-66-2	O	222.24	1.87E-05	4.42E+02	3.03E-01	2.56E-02	6.35E-06	1.08E+03	1.65E-03
Diethylstilbestrol	56-53-1	O	268.36	2.62E-13	4.37E+05	1.50E+02	4.43E-02	8.00E-06	1.30E+04	1.06E-09
Dimethoate	60-51-5	O	229.26	2.58E-09	1.90E+00	8.53E-03	8.00E-02	8.00E-06	2.50E+04	5.09E-06
Dimethoxybenzidine, 3,3'-	119-90-4	O	244.29	1.66E-08	1.22E+02	1.21E-01	2.42E-02	5.50E-06	2.40E+02	2.50E-07
Dimethylbenzidine, 3,3'-	119-93-7	O	212.29	5.40E-09	1.04E+03	3.99E-01	5.10E-02	8.00E-06	2.40E+02	3.70E-07
Dimethyl phenol, 2,4-	105-67-9	O	122.17	8.31E-05	4.05E+02	2.35E-01	5.84E-02	8.69E-06	6.20E+03	1.26E-01
Dinitrobenzene, 1,3-	99-65-0	O	168.11	4.57E-06	4.25E+01	6.00E-02	2.80E-01	7.60E-06	5.40E+02	2.49E-04
Dinitrobenzene, 1,4-	100-25-4	O	168.11	4.44E-06	4.25E+01	5.24E-02	6.15E-02	7.18E-06	1.00E+02	4.83E-05
Dinitrophenol, 2,4-	51-28-5	OA	184.11	2.01E-07	5.32E+01	2.00E-05	2.73E-02	9.06E-06	5.80E+03	1.14E-04
Dinitrotoluene, 2,4-	121-14-2	O	182.14	3.60E-05	1.50E+02	1.03E-01	2.03E-01	7.06E-06	2.85E+02	1.74E-04
Dinitrotoluene, 2,6-	606-20-2	O	182.14	3.11E-05	1.50E+02	8.34E-02	3.27E-02	7.26E-06	1.82E+02	5.70E-04
Dinoseb	88-85-7	O	240.22	2.08E-02	4.71E+03	2.40E+00	2.25E-02	6.25E-06	5.20E+01	7.52E-02
Dioxane, 1,4-	123-91-1	O	88.11	2.04E-04	4.79E-01	1.08E-03	2.30E-01	1.00E-05	9.00E+05	3.80E+01
Diphenylamine	122-39-4	O	169.23	1.83E-04	1.96E+03	6.93E-01	6.80E-02	6.30E-06	3.00E+02	4.26E-03
Diphenylhydrazine, 1,2-	122-66-7	O	184.24	1.42E-07	1.14E+03	1.32E+00	5.62E-02	5.70E-06	1.84E+03	2.60E-05
Diquat dibromide	85-00-7	O	344.05	2.69E-12	1.50E-03	4.10E-01	5.52E-02	5.52E-06	7.00E+05	1.00E-07
Disulfoton	298-04-4	O	274.41	2.58E-04	7.21E+03	1.78E+01	8.00E-02	8.00E-06	1.60E+01	2.30E-04
Diuron	330-54-1	O	233.10	3.04E-08	4.71E+02	8.53E-01	5.40E-02	5.30E-06	4.20E+01	1.00E-07
Endosulfan	115-29-7	O	406.93	4.66E-04	6.90E+03	1.48E+00	1.15E-02	4.55E-06	5.10E-01	9.96E-06
Endothall	145-73-3	O	230.13	1.08E-08	7.81E+01	1.70E-01	CE	CE	1.00E+05	1.80E-04
Endrin	72-20-8	O	380.91	4.95E-05	2.80E+05	1.87E+01	1.25E-02	4.74E-06	2.50E-01	5.84E-07
Epichlorohydrin	106-89-8	O	92.53	1.37E-03	4.23E+00	3.99E-03	8.60E-02	9.80E-06	6.60E+04	1.67E+01

Attachment E:
Chemical/Physical Properties

Chemical of Concern	CAS	Type	MW *(g/mole)*	H '*(unitless)*	K_{ow} *(unitless)*	K_d *(unitless)*	D_{air} *(cm^2/s)*	D_{wat} *(cm^2/s)*	Solubility *(mg/l)*	Vapor Pressure *(mm Hg)*
Ethion	563-12-2	O	384.48	2.87E-05	5.57E+04	3.08E+01	CE	CE	1.20E+00	1.50E-06
Ethoxy ethanol, 2-	110-80-5	O	90.12	2.13E+00	3.84E-01	1.60E-03	9.47E-02	9.75E-06	1.20E+01	4.56E+00
Ethyl acetate	141-78-6	O	88.11	5.57E-03	7.31E+00	1.05E-02	7.30E-02	9.70E-06	7.90E+04	9.41E+01
Ethyl acrylate	140-88-5	O	100.12	1.06E-02	1.66E+01	2.14E-01	7.40E-02	8.68E-06	2.00E+04	2.95E+01
Ethyl benzene	100-41-4	O	106.17	3.28E-01	1.07E+03	4.08E-01	7.50E-02	7.80E-06	1.69E+02	9.60E+00
S-Ethyl dipropylthiocarbamate	759-94-4	O	189.32	4.57E-03	1.04E+03	4.80E-01	5.35E-02	5.65E-06	3.70E+02	1.60E-01
Ethyl ether	60-29-7	O	74.12	2.70E-02	1.12E+01	1.52E-02	7.40E-02	9.30E-06	6.10E+04	5.40E+02
Ethyl methacrylate	97-63-2	O	114.14	6.65E-03	5.84E+01	7.40E-02	8.00E-02	8.00E-06	1.90E+04	1.75E+01
Ethyl-2-methylbenzene, 1-	611-14-3	O	120.19	2.19E-01	3.39E+03	2.15E+00	6.76E-02	7.29E-06	7.46E+01	2.48E+00
Ethyl-4-methylbenzene, 1-	622-96-8	O	120.19	3.27E-01	3.80E+03	2.34E+00	6.70E-02	7.18E-06	9.49E+01	2.95E+00
Ethylenediamine	107-15-3	O	60.10	7.19E-08	2.41E-02	9.42E-03	1.53E-01	1.12E-05	7.95E+06	1.10E+01
Ethylene dibromide	106-93-4	O	187.86	2.93E-02	1.02E+02	1.07E-01	2.17E-02	1.90E-05	4.32E+03	1.10E+01
Ethylene glycol	107-21-1	O	62.07	2.49E-06	6.32E-02	2.52E-04	1.08E-01	1.22E-05	1.00E+06	7.00E-02
Ethylene oxide	75-21-8	O	44.05	4.92E-03	9.01E-01	4.40E-03	1.04E-01	1.45E-05	3.83E+05	1.32E+03
Ethylene thiourea	96-45-7	O	102.16	4.99E-05	3.23E-01	4.38E-04	7.15E-02	1.02E-05	1.20E+04	8.36E-02
Fluoranthene	206-44-0	O	202.26	3.88E-04	8.57E+04	9.80E+01	3.02E-02	6.35E-06	2.60E-01	8.13E-06
Fluorene	86-73-7	O	166.22	2.64E-03	1.04E+04	1.52E+01	3.63E-02	7.88E-06	1.98E+00	3.24E-03
Fluorine (soluble Fluoride)	7782-41-4	I	38.00	CE	1.67E+00	1.50E+02	CE	CE	NA/reacts	7.60E+02
Formaldehyde	50-00-0	O	30.03	1.37E-05	2.24E+00	4.38E-03	1.80E-01	2.00E-05	5.50E+05	3.88E+03
Formic acid	64-18-6	O	46.03	1.79E-04	3.46E-01	5.77E-04	7.90E-02	1.40E-06	1.00E+06	4.10E+01
Furan	110-00-9	O	68.08	2.24E-01	2.31E+01	4.18E-02	1.04E-01	1.20E-05	1.00E+04	6.00E+02
Fufural	98-01-1	O	96.09	1.25E-04	6.80E+00	5.57E-03	8.72E-02	1.12E-05	8.60E+04	2.00E+00
Glycidylaldehyde	765-34-4	O	72.06	1.08E-05	7.63E-01	1.84E-02	9.64E-02	1.16E-05	8.55E+07	2.70E+01
Heptachlor	76-44-8	O	373.32	2.44E-02	1.61E+06	2.35E+01	1.12E-02	5.69E-06	1.80E-01	3.26E-04
Heptachlor epoxide	1024-57-3	O	389.32	3.45E-04	8.04E+04	1.45E+01	1.32E-02	4.23E-06	2.75E-01	4.34E-06
Hexachlorobenzene	118-74-1	O	284.78	2.22E-02	7.24E+05	5.64E+01	5.42E-02	5.91E-06	6.00E-03	1.23E-05
Hexachloro-1,3-butadiene	87-68-3	O	260.76	9.94E-01	5.21E+04	1.38E+01	5.61E-02	6.16E-06	2.55E+00	1.77E-01
Hexachlorocyclohexane, alpha	319-84-6	O	290.83	2.82E-04	1.81E+04	2.64E+00	1.42E-02	7.34E-06	2.00E+00	4.26E-05
Hexachlorocyclohexane, beta	319-85-7	O	290.83	1.44E-05	1.81E+04	2.76E+00	1.42E-02	7.34E-06	5.42E-01	4.90E-07

Attachment E:
Chemical/Physical Properties

Chemical of Concern	CAS	Type	MW *(g/mole)*	H '*(unitless)*	K_{ow} *(unitless)*	K_d *(unitless)*	D_{air} *(cm^2/s)*	D_{wat} *(cm^2/s)*	Solubility *(mg/l)*	Vapor Pressure *(mm Hg)*
Hexachlorocyclohexane, gamma	58-89-9	O	290.83	1.41E-04	1.81E+04	2.19E+00	1.42E-02	7.34E-06	5.75E+00	3.72E-05
Hexachlorocyclohexane, techn	608-73-1	O	290.83	5.99E-05	1.81E+04	4.80E+00	1.42E-02	7.34E-06	4.35E+01	1.64E-04
Hexachlorocyclopentadiene	77-47-4	O	273.78	7.15E-01	4.22E+04	1.91E+01	1.61E-02	7.21E-06	1.80E+00	7.32E-02
Hexachloroethane	67-72-1	O	236.74	1.62E-01	1.08E+04	3.64E+00	2.50E-03	6.80E-06	5.00E+01	4.72E-01
Hexachlorophene	70-30-4	O	406.91	2.54E-09	8.36E+06	4.00E+04	8.00E-02	8.00E-06	3.00E-03	2.74E-12
Hexane, n-	110-54-3	O	86.18	4.66E+01	1.94E+03	9.57E-01	2.00E-01	7.77E-06	1.30E+01	1.52E+02
Hexazinone	51235-04-2	O	252.32	8.62E-11	1.42E+02	7.40E-02	5.08E-02	5.11E-06	3.30E+04	2.03E-07
Hydrazine	302-01-2	O	32.05	7.20E-08	3.41E-02	2.00E-04	4.16E-01	1.90E-05	3.41E+08	1.40E+01
Indeno-(1,2,3-cd)-pyrene	193-39-5	O	276.34	2.85E-06	4.98E+06	6.93E+03	1.90E-02	5.66E-06	3.75E-03	1.40E-10
Isobutyl alcohol	78-83-1	O	74.12	4.99E-04	5.85E+00	1.12E-02	8.60E-02	8.00E-06	9.49E+04	1.00E+01
Isophorone	78-59-1	O	138.21	2.57E-04	4.15E+02	6.04E-02	6.23E-02	6.76E-06	1.20E+04	4.10E-01
Kepone	143-50-0	O	490.64	1.04E-06	8.05E+04	5.40E+01	4.22E-02	4.30E-06	7.60E+00	2.25E-07
Lead	7439-92-1	M	207.20	0.00E+00	5.36E+00	1.00E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Malathion	121-75-5	O	330.36	9.98E-07	1.94E+02	5.77E-01	1.50E-02	4.40E-06	1.45E+02	7.90E-06
Maleic anhydride	108-31-6	O	98.06	8.31E-06	4.16E+01	5.14E-02	9.50E-02	1.11E-05	8.65E+02	1.34E-03
Maleic hydrazide	123-33-1	O	112.09	1.03E-10	1.30E-01	5.00E-02	8.75E-02	8.75E-06	6.00E+03	7.50E-08
Malononitrile	109-77-3	O	66.06	1.97E-07	6.63E-01	9.80E-03	9.97E-02	1.09E-05	6.96E+06	3.79E-01
Manganese	7439-96-5	M	54.94	0.00E+00	1.00E+00	5.01E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mercury	7439-97-6	M	200.59	4.74E-01	3.38E-01	4.00E-02	3.07E-02	6.30E-06	3.00E-02	1.30E-03
Methacrylonitrile	126-98-7	O	67.09	3.03E-03	5.71E+00	6.78E-03	8.00E-02	8.00E-06	2.50E+04	6.80E+01
Methanol	67-56-1	O	32.04	1.94E-04	2.33E-01	3.64E-04	1.50E-01	1.64E-05	1.00E+06	1.22E+02
Methomyl	16752-77-5	O	162.21	7.48E-09	4.07E+00	3.20E-01	4.07E-02	7.20E-06	5.80E+04	5.00E-05
Methoxychlor	72-43-5	O	345.65	6.57E-04	4.65E+05	1.55E+02	1.56E-02	4.46E-06	4.50E-02	1.23E-06
Methoxyethanol	109-86-4	O	76.10	1.28E+00	1.24E-01	1.71E-02	9.15E-02	1.02E-05	2.01E+01	6.20E+00
Methyl ethyl ketone	78-93-3	O	72.11	1.94E-03	1.80E+00	3.80E-03	8.08E-02	9.80E-06	2.40E+05	9.10E+01
Methyl isobutyl ketone	108-10-1	O	100.16	5.82E-03	1.46E+01	3.00E-02	7.50E-02	7.80E-06	1.90E+04	1.45E+01
Methyl mercury	22967-92-6	I	215.62	CE	1.19E+00	---	CE	CE	CE	CE
Methyl methacrylate	80-62-6	O	100.12	1.33E-02	1.88E+01	4.60E-02	7.70E-02	8.60E-06	1.60E+04	3.80E+01
Methyl naphthalene, 2-	91-57-6	O	142.20	1.85E-02	5.20E+03	8.63E+00	6.29E-02	7.20E-06	2.54E+01	6.75E-02

Attachment E:
Chemical/Physical Properties

Chemical of Concern	CAS	Type	MW *(g/mole)*	H '*(unitless)*	K_{ow} *(unitless)*	K_d *(unitless)*	D_{air} *(cm^2/s)*	D_{wat} *(cm^2/s)*	Solubility *(mg/l)*	Vapor Pressure *(mm Hg)*
Methyl parathion	298-00-0	O	263.21	5.82E-06	5.61E+02	1.30E+00	8.00E-02	8.00E-06	5.00E+01	1.52E-05
Methylene-bis (2-chloroaniline), 4,4'-	101-14-4	O	267.16	1.40E-05	2.95E+03	1.58E+01	1.99E-02	5.80E-06	7.24E+01	6.94E-05
Methylene chloride	75-09-2	O	84.93	9.10E-02	2.19E+01	2.35E-02	1.01E-01	1.17E-05	1.54E+04	4.55E+02
Molinate	2212-67-1	O	187.31	5.25E-05	8.05E+02	1.00E-01	5.65E-02	6.00E-06	9.00E+02	5.60E-03
Molybdenum	7439-98-7	M	95.94	0.00E+00	1.00E+00	2.00E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MTBE	1634-04-4	O	88.15	2.44E-02	2.69E+01	2.83E-02	7.92E-02	9.41E-05	4.80E+04	2.49E+02
Naled	300-76-5	O	380.78	2.71E-03	4.02E+01	2.66E-01	CE	6.80E-06	1.50E+00	2.00E-04
Naphthalene	91-20-3	O	128.17	2.00E-02	1.48E+03	3.10E+00	5.90E-02	7.50E-06	3.14E+01	8.89E-02
Nickel and compounds (soluble salts)	7440-02-0	M	58.69	0.00E+00	2.69E-01	1.60E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nitrate	14797-55-8	I	62.00	CE	1.62E+00	---	CE	CE	CE	CE
Nitrite	14797-65-0	I	46.01	CE	1.14E+00	---	CE	CE	CE	CE
Nitroaniline 2-	88-74-4	O	138.13	2.08E-05	1.04E+02	5.38E-02	5.99E-02	7.18E-06	1.26E+03	4.75E-03
Nitrobenzene	98-95-3	O	123.11	8.56E-04	6.47E+01	2.64E-01	7.60E-02	8.60E-06	1.90E+03	2.44E-01
Nitropropane, 2-	79-46-9	O	89.09	5.15E-03	7.44E+00	7.00E-03	9.23E-02	1.01E-05	1.70E+04	1.82E+01
Nitroso-n-ethylurea, n-	759-73-9	O	117.11	1.05E-04	9.45E-01	6.47E-02	8.08E-02	8.25E-06	4.85E+04	7.97E-01
Nitroso-methyl-ethyl-amine, n-	10595-95-6	O	88.11	3.70E-05	7.12E-01	4.20E-02	8.00E-02	8.00E-06	3.00E+05	2.28E+00
Nitrosodi-n-butylamine, n-	924-16-3	O	158.24	3.58E-03	2.03E+02	4.60E-01	8.00E-02	8.00E-06	1.20E+03	2.89E-01
Nitrosodi-n-propylamine, n-	621-64-7	O	130.19	9.35E-05	2.25E+01	3.94E-02	5.45E-02	8.17E-06	9.89E+03	4.00E-01
Nitrosodiethanolamine	1116-54-7	O	134.14	2.05E-09	5.25E-02	5.98E-03	7.27E-02	7.70E-06	7.33E+07	5.00E-04
Nitrosodiethylamine, N-	55-18-5	O	102.14	3.60E-05	2.21E+00	6.00E-03	8.00E-02	8.00E-06	1.47E+05	1.42E+00
Nitrosodimethylamine, N-	62-75-9	O	74.08	2.16E-05	2.30E-01	7.20E-03	1.34E-01	9.72E-06	1.00E+06	5.37E+00
Nitrosodiphenylamine	86-30-6	O	198.22	2.08E-04	1.45E+03	6.62E-01	3.12E-02	6.35E-06	3.51E+01	9.88E-02
Nitrosopyrrolidine, n-	930-55-2	O	100.12	7.48E-07	1.70E+00	1.30E-03	8.00E-02	8.00E-06	7.80E+05	1.75E-01
Nitrotoluene, m	99-08-1	O	137.14	2.24E-03	2.28E+02	2.81E-01	6.42E-02	7.69E-06	4.98E+02	1.50E-01
Nitrotoluene, o	88-72-2	O	137.14	1.87E-03	2.28E+02	2.81E-01	6.47E-02	7.73E-06	6.00E+02	1.50E-01
Nitrotoluene, p	99-99-0	O	137.14	2.29E-03	2.28E+02	2.81E-01	6.40E-02	7.70E-06	4.00E+02	1.20E-01
Octamethylpryrophosphoramide	152-16-9	O	286.25	1.16E-08	9.84E-02	6.20E-04	8.00E-02	8.00E-06	1.00E+06	9.88E-04
Oxamyl	23135-22-0	O	219.26	1.60E-11	6.32E-02	1.00E-02	5.57E-02	5.75E-06	2.80E+05	3.83E-07
Parathion	56-38-2	O	291.26	2.37E-05	5.38E+03	1.12E+01	1.70E-02	5.80E-06	1.18E+01	1.73E-05

Attachment E:
Chemical/Physical Properties

Chemical of Concern	CAS	Type	MW *(g/mole)*	H '*(unitless)*	K_{ow} *(unitless)*	K_d *(unitless)*	D_{air} *(cm^2/s)*	D_{wat} *(cm^2/s)*	Solubility *(mg/l)*	Vapor Pressure *(mm Hg)*
Pebulate	1114-71-2	O	203.35	9.85E-04	3.23E+03	8.60E-01	5.10E-02	5.38E-06	9.20E+01	8.85E-03
Pentachlorobenzene	608-93-5	O	250.34	3.16E-02	1.64E+05	6.32E+01	6.70E-02	6.30E-06	6.50E-01	1.67E-03
Pentachloronitrobenzene	82-68-8	O	295.34	2.57E-02	1.08E+05	2.60E+01	1.59E-02	6.10E-06	7.11E-02	1.13E-04
Pentachlorophenol	87-86-5	OA	266.34	1.16E-05	5.44E+04	8.20E-01	5.60E-02	6.10E-06	1.40E+01	1.70E-05
Phenanthrene	85-01-8	O	178.23	5.40E-03	2.21E+04	2.83E+01	3.33E-02	7.47E-06	9.94E-01	6.80E-04
Phenol	108-95-2	O	94.11	2.47E-05	3.26E+01	3.48E-02	8.20E-02	9.10E-06	8.70E+04	4.63E-01
Phenyl mercuric acetate	62-38-4	O	336.74	3.41E-09	7.76E+00	3.20E-01	8.00E-02	8.00E-06	4.37E+03	3.04E-06
Phenylene diamine, m-	108-45-2	O	108.14	9.56E-07	4.06E-01	2.20E-03	6.63E-02	9.90E-06	3.51E+05	2.28E-02
Phenylene diamine, p-	106-50-3	O	108.14	5.24E-08	4.06E-01	2.20E-03	7.15E-02	8.92E-06	3.80E+04	4.60E-03
Phorate	298-02-2	O	260.38	4.99E-04	2.33E+03	1.10E+01	8.00E-02	8.00E-06	4.40E+01	1.30E-03
Phosphine	7803-51-2	I	34.00	1.46E+02	5.36E-01	---	3.81E-01	1.82E-05	4.00E+02	3.14E+04
Phosphorus, white	7723-14-0	I	123.90	5.65E-02	1.20E+03	2.24E+00	CE	CE	3.00E+00	2.50E-02
Phthalic anhydride	85-44-9	O	148.12	2.54E-07	1.17E+02	1.59E-01	6.36E-02	7.90E-06	6.20E+03	2.00E-04
Polybrominated biphenyls	67774-32-7	O	627.59	1.62E-04	2.45E+06	4.28E+00	CE	4.63E-06	1.10E-02	5.20E-08
Polychlorinated biphenyls	1336-36-3	O	290.00	1.75E-02	2.00E+06	1.06E+03	1.04E-01	1.00E-05	5.55E-02	7.60E-05
Pronamide	23950-58-5	O	256.13	3.74E-04	3.76E+03	4.00E-01	8.00E-02	8.00E-06	1.50E+01	4.00E-04
Propargite	2312-35-8	O	350.48	1.44E-06	5.37E+03	1.12E+01	3.94E-02	4.20E-06	5.00E-01	4.48E-08
Propargyl alcohol	107-19-7	O	56.06	1.34E-05	3.79E-01	1.08E-02	1.04E-01	1.24E-05	5.57E+06	1.20E+01
Propham	122-42-9	O	179.22	5.30E-06	4.57E+02	1.02E-01	5.71E-02	6.28E-06	2.50E+02	1.35E-04
Propylene oxide	75-56-9	O	58.08	3.47E-03	1.07E+00	2.53E-03	1.04E-01	1.16E-05	4.76E+05	5.32E+02
Pyrene	129-00-0	O	202.26	4.57E-04	8.57E+04	7.60E+01	2.72E-02	7.24E-06	1.35E-01	4.25E-06
Pyridine	110-86-1	O	79.10	2.91E-01	6.38E+00	8.80E-03	9.10E-02	7.60E-06	3.00E+02	2.00E+01
Quinoline	91-22-5	O	129.16	1.15E-04	1.39E+02	1.14E+00	5.46E-02	8.31E-06	6.78E+03	9.60E-02
Selenium	7782-49-2	M	78.96	0.00E+00	1.73E+00	2.20E+00	CE	CE	0.00E+00	0.00E+00
Selenourea	630-10-4	O	118.98	CE	2.35E-03	---	CE	CE	CE	CE
Silver	7440-22-4	M	107.87	0.00E+00	1.00E+00	1.00E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sodium diethyldithiocarbamate	148-18-5	O	171.26	CE	1.86E+00	---	CE	CE	CE	CE
Strychnine	57-24-9	O	334.42	6.65E-12	7.04E+01	1.58E-01	8.00E-02	8.00E-06	1.43E+02	1.67E-10
Styrene	100-42-5	O	104.15	1.14E-01	7.85E+02	1.52E+00	7.10E-02	8.00E-06	3.10E+02	6.24E+00

Attachment E:
Chemical/Physical Properties

Chemical of Concern	CAS	Type	MW *(g/mole)*	H '*(unitless)*	K_{ow} *(unitless)*	K_d *(unitless)*	D_{air} *(cm^2/s)*	D_{wat} *(cm^2/s)*	Solubility *(mg/l)*	Vapor Pressure *(mm Hg)*
TCDDioxins, 2,3,7,8-	1746-01-6	O	321.97	1.47E-03	1.05E+07	2.83E+04	4.70E-02	8.00E-06	1.93E-05	7.40E-10
Tetrachlorobenzene, 1,2,4,5-	95-94-3	O	215.89	4.99E-02	3.72E+04	3.20E+00	2.11E-02	8.80E-06	3.00E-01	5.40E-03
Tetrachloroethane, 1,1,1,2-	630-20-6	O	167.85	9.98E-02	8.57E+02	1.91E+00	7.10E-02	7.90E-06	1.10E+03	1.22E+01
Tetrachloroethane, 1,1,2,2-	79-34-5	O	167.85	1.55E-02	1.56E+02	1.55E-01	7.10E-02	7.90E-06	2.97E+03	5.17E+00
Tetrachloroethylene	127-18-4	O	165.83	7.65E-01	9.23E+02	3.10E-01	7.20E-02	8.20E-06	2.00E+02	1.84E+01
Tetrachlorophenol, 2,3,4,6-	58-90-2	OA	231.89	2.54E-04	1.23E+04	2.10E-01	2.17E-02	7.10E-06	1.00E+02	5.02E-03
Tetraethyl dithiopyrophosphate	3689-24-5	O	322.32	1.75E-04	9.56E+03	1.48E+00	1.50E-02	5.50E-06	2.50E+01	1.70E-04
Tetraethyl lead	78-00-2	O	323.45	3.31E+00	7.63E+04	9.80E+00	1.32E-02	6.40E-06	8.00E-01	1.50E-01
Thallium chloride	7791-12-0	I	239.84	0.00E+00	---	---	CE	CE	2.90E+03	0.00E+00
Thiofanox	39196-18-4	O	218.32	3.90E-07	1.44E+02	1.18E-01	2.55E-02	6.62E-06	5.20E+03	3.10E-04
Thiophanatemethyl	23564-05-8	O	342.40	3.82E-07	3.16E+01	1.80E-02	4.55E-02	4.68E-06	3.50E+00	7.50E-08
Thiram	137-26-8	O	240.44	3.28E-06	5.05E+01	1.34E+00	2.25E-02	6.24E-06	3.00E+01	7.50E-06
Tin	7440-31-5	M	118.71	0.00E+00	1.95E+01	---	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Toluene	108-88-3	O	92.14	2.76E-01	3.47E+02	2.80E-01	8.70E-02	8.60E-06	5.30E+02	2.82E+01
Toluenediamine, 2,4-	95-80-7	O	122.17	7.48E-08	1.43E+00	2.58E+00	8.00E-02	8.00E-06	7.47E+03	8.36E-05
Toluenediamine, 2,6-	823-40-5	O	122.17	5.15E-10	1.43E+00	---	6.87E-02	7.97E-06	4.80E+04	1.98E-05
Toluene diisocyanate, 2,4/2,6-	26471-62-5	O	174.16	6.86E-06	5.50E+03	4.51E+00	6.09E-02	6.80E-06	1.11E+05	8.00E-02
Toluidine, p-	106-49-0	O	107.16	3.82E-04	4.20E+01	5.00E-02	8.00E-02	8.00E-06	7.20E+03	3.30E-01
Toxaphene	8001-35-2	O	413.81	1.40E-04	6.24E+06	1.92E+02	1.16E-02	4.34E-06	7.40E-01	4.19E-06
TP Silvex, 2,4,5-	93-72-1	O	269.51	5.45E-07	4.78E+03	5.20E+00	1.94E-02	5.80E-06	1.40E+02	5.20E-06
Triallate	2303-17-5	O	304.67	4.53E-04	3.70E+04	2.88E+00	4.58E-02	4.84E-06	4.00E+00	1.20E-04
Bis (tri-n-butyltin) oxide	56-35-9	O	596.11	2.08E-03	6.25E+05	---	CE	CE	1.80E+01	6.91E-05
Trichloro-1,2,2-trifluoroethane, 1,1,2	76-13-1	O	187.38	2.20E+01	1.24E+03	2.58E+00	7.80E-02	8.20E-06	2.00E+02	3.60E+02
Trichlorobenzene, 1,2,4-	120-82-1	O	181.45	5.90E-02	8.44E+03	3.32E+00	3.00E-02	8.23E-06	4.88E+01	3.36E-01
Trichloroethane, 1,1,1-	71-55-6	O	133.40	7.15E-01	4.78E+02	2.19E-01	7.80E-02	8.80E-06	1.33E+03	1.24E+02
Trichloroethane, 1,1,2-	79-00-5	O	133.40	3.80E-02	1.03E+02	1.00E-01	7.92E-02	8.80E-06	4.42E+03	2.52E+01
Trichloroethylene	79-01-6	O	131.39	4.28E-01	2.97E+02	1.87E-01	7.90E-02	9.10E-06	1.10E+03	7.20E+01
Trichlorofluoromethane	75-69-4	O	137.37	4.03E+00	1.35E+02	2.70E-01	8.70E-02	9.70E-06	1.10E+03	6.87E+02
Trichlorophenol, 2,4,5-	95-95-4	OA	197.45	1.78E-04	2.79E+03	5.96E-01	2.91E-02	7.03E-06	1.20E+03	1.63E-02

Attachment E:
Chemical/Physical Properties

Chemical of Concern	CAS	Type	MW *(g/mole)*	H '*(unitless)*	K_{ow} *(unitless)*	K_d *(unitless)*	D_{air} *(cm^2/s)*	D_{wat} *(cm^2/s)*	Solubility *(mg/l)*	Vapor Pressure *(mm Hg)*
Trichlorophenol, 2,4,6-	88-06-2	OA	197.45	3.19E-04	2.79E+03	2.62E-01	3.18E-02	6.25E-06	9.82E+02	1.18E-02
Trichlorophenoxyacetic acid, 2,4,5-	93-76-5	O	255.48	3.62E-07	1.83E+03	1.06E-01	8.00E-02	8.00E-06	2.78E+02	3.61E-06
Trichloropropane, 1,1,2-	598-77-6	O	147.43	1.21E+00	2.69E+02	3.47E-01	3.96E-02	9.30E-06	4.44E+01	6.64E+00
Trichloropropane, 1,2,3-	96-18-4	O	147.43	1.58E-02	3.19E+02	7.78E-01	7.10E-02	7.90E-06	1.90E+03	3.70E+00
Triethylamine	121-44-8	O	101.19	1.99E-02	3.25E+01	2.67E-02	7.54E-02	7.51E-06	1.50E+04	5.00E+01
Trifluralin	1582-09-8	O	335.28	2.01E-03	2.05E+05	2.74E+01	1.49E-02	4.70E-06	6.00E-01	1.10E-04
Trimethylbenzene, 1,2,3-	526-73-8	O	120.19	1.33E-01	3.55E+03	1.18E+00	6.77E-02	7.41E-06	7.52E+01	1.49E+00
Trinitrobenzene, 1,3,5-	99-35-4	O	213.11	2.87E-06	2.79E+01	2.83E-02	8.00E-02	8.00E-06	3.53E+02	9.90E-05
Trinitrophenylmethylnitramine, 2,4,6-	479-45-8	O	287.15	8.31E-11	1.10E+02	4.69E-01	5.69E-02	6.40E-06	7.50E+01	4.00E-10
Trinitrotoluene, 2,4,6-	118-96-7	O	227.13	1.90E-05	9.85E+01	6.04E-01	5.41E-02	6.57E-06	1.30E+02	1.24E-04
Uranium	7440-61-1	M	238.03	0.00E+00	1.00E+00	2.96E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Vanadium	7440-62-2	M	50.94	0.00E+00	1.00E+00	1.00E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Vernam	1929-77-7	O	203.35	7.36E-04	3.23E+03	5.51E+00	5.10E-02	5.39E-06	9.85E+01	1.04E-02
Vinyl acetate	108-05-4	O	86.09	2.29E-02	5.34E+00	1.05E-02	8.50E-02	9.20E-06	2.00E+04	1.09E+02
Vinyl chloride	75-01-4	O	62.50	3.49E+00	4.20E+01	2.19E-02	1.06E-01	1.23E-05	2.76E+03	2.80E+03
Warfarin	81-81-2	O	308.33	1.15E-07	1.58E+03	1.82E+00	1.63E-02	4.40E-06	1.70E+01	1.16E-07
Xylene, m-	108-38-3	O	106.17	3.05E-01	1.58E+03	3.92E-01	7.00E-02	7.80E-06	1.60E+02	8.00E+00
Xylene, o-	95-47-6	O	106.17	7.36E-04	1.35E+03	2.58E-01	8.70E-02	1.00E-05	1.78E+02	6.75E+00
Xylene, p-	106-38-3	O	106.17	3.18E-01	1.48E+03	6.18E-01	7.69E-02	8.44E-06	1.85E+02	8.76E+00
Xylenes	1330-20-7	O	106.17	2.93E-01	1.22E+03	4.80E-01	7.40E-02	8.50E-06	1.98E+02	8.06E+00
Zinc	7440-66-6	M	65.39	0.00E+00	3.38E-01	1.60E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Type - O: Organic, I: Inorganic, M: Metal, OA: Organic Acid
MW - Molecular Weight (g/mole)
H' - Dimensionless Henry's Law Constant H' = H x 41.57 @ 20ºC (cm^3-H_2O/cm^3-air)
K_{ow} - Octanol-water partition coefficient (cm^3-H_2O/cm^3-Octanol)
K_d - Soil-water partition coefficient (cm^3-H_2O/g-Soil)
D_{air} - Diffusion coefficient in air (cm^2/s)
D_{wat} - Diffusion coefficient in water (cm^2/s)

CE - Not found; cannot estimate
NA/reacts - Not applicable because reacts with water
Values in italics - Estimated by TNRCC

Implementation schedule for new risk reduction rule guidance

Regulatory direction for any site (or unique project within a site) under jurisdiction of 30 Texas Administrative Code (TAC) §335.551-599 is required to conform with the July 23, 1998, guidance memorandum Implementation of the Existing Risk Reduction Rule. The TNRCC recognizes that sites or unique projects may currently have submitted reports or approved proposals. Therefore, in an effort to promote reasonableness, exceptions to this requirement may be made for approved/submitted reports and proposals for sites (projects) which meet one of the following conditions and were received by October 15, 1998:

(1) the TNRCC has approved a Baseline Risk Assessment Report;
(2) a Baseline Risk Assessment has been submitted that is substantially complete with conclusions that are health protective and acceptable to TNRCC. The intent of this option is to recognize conclusions which are protective of human health, but which may be based on alternate assumptions and methodologies; or
(3) a site investigation/remediation report has been submitted that is substantially complete with conclusions that are health protective and acceptable to the TNRCC, and which includes elements such that the document is considered equivalent to a Baseline Risk Assessment as detailed below.

Submittals that are considered equivalent to an acceptable Baseline Risk Assessment Report include:

- a site investigation report sufficient to determine that a risk assessment and remedial action are not warranted.

- remedial actions as appropriate under the existing Risk Reduction Rule. This includes submittals that propose/document:

    a. cleanup to background;
    b. cleanup to Practical Quantitation Limits (PQLs) as defined in §335.554(d);
    c. cleanup to TNRCC accepted health-based levels that include all appropriate exposure pathways; or
    d. a remedial action that eliminates all potential exposure pathways by institutional and/or engineering controls.

Your TNRCC project manager/coordinator may be contacted as necessary for clarification and assistance on site specific issues. As the guidance memorandum is used by the public and agency staff, the document will be evaluated and possibly revised to more appropriately clarify the Risk Reduction Rule. If modifications and/or additions occur, the TNRCC will aim to keep the public informed through the Internet.

September 11, 1998, ERRATUM sheet to the July 23, 1998 memorandum from Ron Pedde regarding the implementation of the existing risk reduction rules (the "Consistency Document"). The text on this sheet should replace the text in Section B.1.1.6 of the Consistency Document.

B.1.1.6. Sample Quantitation Limit

The sample quantitation limit (SQL) is the MDL adjusted to reflect sample characteristics and sample-specific action(s) performed by the laboratory that are necessary but not prescribed in the analytical method. The SQL takes into account the individual sample matrix characteristics, sample preparation, and/or analytical adjustments and represents the level below which the compound was not detected in that specific sample by the laboratory. Sample-specific actions that affect the SQL might include diluting the sample, concentrating the sample, and/or using a smaller or larger aliquot size than that prescribed in the method. Sample characteristics that affect the SQL may include the moisture content in the sample, the matrix of the sample, and/or the concentration of contaminants in the sample. Because the SQL is sample-specific, the SQL in one sample may be higher than, lower than, or equal to the SQL value for the same contaminant in another sample because the matrix of one sample may require more manipulations by the laboratory than the other. Therefore, SQLs are the most relevant reporting limits for evaluating nondetected compounds in specific samples.

Proper application of the analytical method includes the use of instrument calibration that brackets the values reported. When the concentration of a compound in a sample exceeds the calibration range, the laboratory dilutes the sample. Since the SQL is a function of the MDL, this dilution raises the SQL to a value equal to the MDL multiplied by the dilution factor and multiplied by any other factors associated with the sample characteristics and/or sample-specific action taken by the laboratory.

Dilution of samples is sometime necessary. For a compound that is detected in dilutions of the same sample, the reported result should be from the lowest dilution analysis where the compound was measured within the linear portion of the calibration curve. The laboratory should report the dilution factor for the result and flag the result, e..g, 175D. With each manipulation of the sample, the potential for error to be introduced into the result increases. Therefore, the data user can review the blank data and the results of lower dilutions when conducting an assessment of the data.

Attachment C:
Dermal and GI Absorption Factors

COC	CAS #	ABS.gi (unitless)	Reference	ABS.d (unitless)	Reference
Acenaphthene	83-32-9	8.9E-01	Hecht, 1979	1.3E-01	Wester *et al*., 1990
Acenaphthylene	208-96-8	8.9E-01	Hecht, 1979	1.3E-01	Wester *et al*., 1990
Acetaldehyde	75-07-0	8.0E-01	default[a]	0.0E+00	default[b]
Acetone	67-64-1	8.3E-01	Bast and Borges, 1998	0.0E+00	default[b]
Acetone cyanohydrin	75-86-5	5.0E-01	default[a]	1.0E-01	default[b]
Acetonitrile	75-05-8	8.0E-01	default[a]	0.0E+00	default[b]
Acetophenone	98-86-2	5.0E-01	default[a]	1.0E-01	default[b]
Acifluorfen, sodium	62476-59-9	5.0E-01	default[a]	1.0E-01	default[b]
Acrolein	107-02-8	8.0E-01	default[a]	0.0E+00	default[b]
Acrylamide	79-06-1	5.0E-01	default[a]	1.0E-01	default[b]
Acrylic acid	79-10-7	8.0E-01	default[a]	0.0E+00	default[b]
Acrylonitrile	107-13-1	8.0E-01	default[a]	0.0E+00	default[b]
Alachlor	15972-60-8	5.0E-01	default[a]	1.0E-01	default[b]
Aldicarb	116-06-3	5.0E-01	default[a]	1.0E-01	default[b]
Aldicarb sulfone	1646-88-4	5.0E-01	default[a]	1.0E-01	default[b]
Aldrin	309-00-2	5.0E-01	Bast and Borges, 1998	1.0E-01	default[b]
Allyl alcohol	107-18-6	8.0E-01	default[a]	0.0E+00	default[b]
Allyl chloride	107-05-1	8.0E-01	default[a]	0.0E+00	default[b]
Aluminum	7429-90-5	1.0E-01	Bast and Borges, 1998	1.0E-02	default[b]
Aminopyridine, 4-	504-24-5	5.0E-01	default[a]	1.0E-01	default[b]
Ammonia	7664-41-7	2.0E-01	default[a]	1.0E-02	default[b]
Aniline	62-53-3	5.0E-01	default[a]	1.0E-01	default[b]
Anthracene	120-12-7	8.9E-01	Hecht, 1979	1.3E-01	Wester *et al*., 1990
Antimony	7440-36-0	1.5E-01	Waitz, 1965	1.0E-02	default[b]

Attachment C:
Dermal and GI Absorption Factors

COC	CAS #	ABS.gi (unitless)	Reference	ABS.d (unitless)	Reference
Aramite	140-57-8	5.0E-01	default[a]	1.0E-01	default[b]
Arsine	7784-42-1	2.0E-01	default[a]	1.0E-02	default[b]
Asbestos	1332-21-4	2.0E-01	default[a]	1.0E-02	default[b]
Atrazine	1912-24-9	5.0E-01	default[a]	1.0E-01	default[b]
Barium	7440-39-3	7.0E-02	Taylor, 1962; Cuddihy and Griffith, 1972	1.0E-02	default[b]
Benzene	71-43-2	9.7E-01	Bast and Borges, 1998	0.0E+00	default[b]
Benzenethiol	108-98-5	8.0E-01	default[a]	0.0E+00	default[b]
Benzidine	92-87-5	8.0E-01	Bast and Borges, 1998	1.0E-01	default[b]
Benz-a-anthracene	56-55-3	8.9E-01	Hecht, 1979	1.3E-01	Wester *et al*., 1990
Benzo-a-pyrene	50-32-8	8.9E-01	Hecht, 1979	1.3E-01	Wester *et al*., 1990
Benzo-b-fluoranthene	205-99-2	8.9E-01	Hecht, 1979	1.3E-01	Wester *et al*., 1990
Benzo-k-fluoranthene	207-08-9	8.9E-01	Hecht, 1979	1.3E-01	Wester *et al*., 1990
Benzo-g,h,i-perylene	191-24-2	8.9E-01	Hecht, 1979	1.3E-01	Wester *et al*., 1990
Benzoic acid	65-85-0	1.0E+00	Bast and Borges, 1998	1.0E-01	default[b]
Benzotrichloride	98-07-7	5.0E-01	default[a]	1.0E-01	default[b]
Benzyl alcohol	100-51-6	6.6E-01	Bast and Borges, 1998	1.0E-01	default[b]
Benzyl chloride	100-44-7	8.0E-01	default[a]	0.0E+00	default[b]
Beryllium	7440-41-7	7.0E-03	Reeves, 1965	1.0E-02	default[b]
Biphenyl, 1,1-	92-52-4	5.0E-01	default[a]	1.0E-01	default[b]
Bis (2-chloro-ethyl) ether	111-44-4	8.0E-01	default[a]	0.0E+00	default[b]
Bis (2-chloroisopropyl) ether	39638-32-9	5.0E-01	default[a]	1.0E-01	default[b]
Bis (2-chloromethyl) ether	542-88-1	8.0E-01	default[a]	0.0E+00	default[b]
Bis (2-ethyl-hexyl) phthalate	117-81-7	1.9E-01	Bast and Borges, 1998	1.0E-01	default[b]
Bromodichloromethane	75-27-4	9.8E-01	Bast and Borges, 1998	0.0E+00	default[b]

Attachment C:
Dermal and GI Absorption Factors

COC	CAS #	ABS.gi (unitless)	Reference	ABS.d (unitless)	Reference
Bromoform	75-25-2	6.0E-01	Bast and Borges, 1998	0.0E+00	default[b]
Bromomethane	74-83-9	8.0E-01	default[a]	0.0E+00	default[b]
Butadiene, 1,3-	106-99-0	8.0E-01	default[a]	0.0E+00	default[b]
Butanol, n-	71-36-3	8.0E-01	default[a]	0.0E+00	default[b]
Butylate	2008-41-5	5.0E-01	default[a]	1.0E-01	default[b]
Butyl benzyl phthalate	85-68-7	6.1E-01	Bast and Borges, 1998	1.0E-01	default[b]
Cacodylic acid	75-60-5	5.0E-01	default[a]	1.0E-01	default[b]
Cadmium	7440-43-9	2.5E-02	IRIS, 1998	1.0E-02	Wester *et al*., 1992a; USEPA, 1992e
Captan	133-06-2	5.0E-01	default[a]	1.0E-01	default[b]
Carbaryl	63-25-2	5.0E-01	default[a]	1.0E-01	default[b]
Carbazole	86-74-8	7.0E-01	Bast and Borges, 1998	1.0E-01	default[b]
Carbofuran	1563-66-2	5.0E-01	default[a]	1.0E-01	default[b]
Carbon disulfide	75-15-0	6.3E-01	Bast and Borges, 1998	0.0E+00	default[b]
Carbon tetrachloride	56-23-5	6.5E-01	Bast and Borges, 1998	0.0E+00	default[b]
Carbosulfan	55285-14-8	5.0E-01	default[a]	1.0E-01	default[b]
Chloral	75-87-6	8.0E-01	default[a]	0.0E+00	default[b]
Chlordane	57-74-9	8.0E-01	Ohno, 1986; Ewing, 1985	4.0E-02	Wester *et al*., 1992b
Chlorine	7782-50-5	2.0E-01	default[a]	1.0E-02	default[b]
Chloroanaline, p-	106-47-8	5.0E-01	default[a]	1.0E-01	default[b]
Chlorobenzene	108-90-7	3.1E-01	Bast and Borges, 1998	0.0E+00	default[b]
Chlorobenzilate	510-15-6	5.0E-01	default[a]	1.0E-01	default[b]
Chloro-1,3-butadiene, 2-	126-99-8	8.0E-01	default[a]	0.0E+00	default[b]
Chlorodifluoromethane	75-45-6	8.0E-01	default[a]	0.0E+00	default[b]

Attachment C:
Dermal and GI Absorption Factors

COC	CAS #	ABS.gi (unitless)	Reference	ABS.d (unitless)	Reference
Chloroethane	75-00-3	8.0E-01	default[a]	0.0E+00	default[b]
Chloroform	67-66-3	2.0E-01	Bast and Borges, 1998	0.0E+00	default[b]
Chloromethane	74-87-3	8.0E-01	default[a]	0.0E+00	default[b]
Chloronaphthalene, 2-	91-58-7	8.9E-01	Hecht, 1979	1.3E-01	Wester *et al*., 1990
Chlorophenol, 2-	95-57-8	8.0E-01	default[a]	0.0E+00	default[b]
Chlorotoluene, o-	95-49-8	8.0E-01	default[a]	0.0E+00	default[b]
Chlorpyrifos	2921-88-2	5.0E-01	default[a]	1.0E-01	default[b]
Chromium (III)	16065-83-1	1.3E-02	Donaldson and Barreras, 1966; Keim,	1.0E-02	default[b]
Chromium (VI)	18540-29-9	2.5E-02	Donaldson and Barreras, 1966; Sayto, 1980; MacKenzie,	1.0E-02	default[b]
Chrysene	218-01-9	8.9E-01	Hecht, 1979	1.3E-01	Wester *et al*., 1990
Cobalt	7440-48-4	8.0E-01	Bast and Borges, 1998	1.0E-02	default[b]
Copper	7440-50-8	5.7E-01	Strickland, 1972	1.0E-02	default[b]
Cresol, m-	108-39-4	5.0E-01	default[a]	1.0E-01	default[b]
Cresol, o-	95-48-7	5.0E-01	default[a]	1.0E-01	default[b]
Cresol, p-	106-44-5	6.5E-01	Bast and Borges, 1998	1.0E-01	default[b]
Crotonaldehyde	123-73-9	8.0E-01	default[a]	0.0E+00	default[b]
Cumene	98-82-8	8.0E-01	default[a]	0.0E+00	default[b]
Cyanide	57-12-5	>5.0E-01	Farooqui and Ahmed, 1982	1.0E-02	default[b]
Cyanogen	460-19-5	8.0E-01	default[a]	0.0E+00	default[b]
Cyclohexanone	108-94-1	8.0E-01	default[a]	0.0E+00	default[b]
Cyclotrimethylenetrinitramine	121-82-4	1.0E+00	Bast and Borges, 1998	1.0E-01	default[b]

Attachment C:
Dermal and GI Absorption Factors

COC	CAS #	ABS.gi (unitless)	Reference	ABS.d (unitless)	Reference
DDD	72-54-8	7.0E-01	Keller, 1980	3.0E-02	Wester *et al*., 1990
DDE	72-55-9	7.0E-01	Keller, 1980	3.0E-02	Wester *et al*., 1990
DDT	50-29-3	7.0E-01	Keller, 1980	3.0E-02	Wester *et al*., 1990
Di-n-butyl phthalate	84-74-2	1.0E+00	Bast and Borges, 1998	1.0E-01	default[b]
Di-n-octyl phthalate	117-84-0	9.0E-01	Bast and Borges, 1998	1.0E-01	default[b]
Diallate	2303-16-4	5.0E-01	default[a]	1.0E-01	default[b]
Diazinon	333-41-5	5.0E-01	default[a]	1.0E-01	default[b]
Dibenz-a,h-anthracene	53-70-3	8.9E-01	Hecht, 1979	1.3E-01	Wester *et al*., 1990
Dibromo-3-chloropropane, 1,2-	96-12-8	5.0E-01	default[a]	1.0E-01	default[b]
Dibromochloromethane	124-48-1	6.0E-01	Bast and Borges, 1998	0.0E+00	default[b]
Dicamba	1918-00-9	5.0E-01	default[a]	1.0E-01	default[b]
Dichlorobenzene, 1,2-	95-50-1	8.0E-01	default[a]	0.0E+00	default[b]
Dichlorobenzene, 1,4-	106-46-7	9.0E-01	Bast and Borges, 1998	0.0E+00	default[b]
Dichlorobenzidine, 3,3-	91-94-1	5.0E-01	default[a]	1.0E-01	default[b]
Dichloro-2-butene, 1,4-	764-41-0	8.0E-01	default[a]	0.0E+00	default[b]
Dichlorodifluoromethane	75-71-8	2.3E-01	Bast and Borges, 1998	0.0E+00	default[b]
Dichloroethane, 1,1-	75-34-3	1.0E+00	Bast and Borges, 1998	0.0E+00	default[b]
Dichloroethane, 1,2-	107-06-2	1.0E+00	Bast and Borges, 1998	0.0E+00	default[b]
Dichloroethylene, 1,1-	75-35-4	1.0E+00	Bast and Borges, 1998	0.0E+00	default[b]
Dichloroethylene, cis-1,2-	156-59-2	1.0E+00	Bast and Borges, 1998	0.0E+00	default[b]
Dichloroethylene, trans-1,2	156-60-5	1.0E+00	Bast and Borges, 1998	0.0E+00	default[b]
Dichlorophenol, 2,4-	120-83-2	8.2E-01	Bast and Borges, 1998	1.0E-01	default[b]
Dichlorophenoxyacetic acid, 2,4-	94-75-7	>9.0E-01	Pelletier, 1989; Knopp, 1992	5.0E-02	Wester *et al*., 1996
Dichloropropane, 1,2-	78-87-5	7.4E-01	Bast and Borges, 1998	0.0E+00	default[b]

Attachment C:
Dermal and GI Absorption Factors

COC	CAS #	ABS.gi (unitless)	Reference	ABS.d (unitless)	Reference
Dichloropropanol, 2,3-	616-23-9	5.0E-01	default[a]	1.0E-01	default[b]
Dichloropropene, 1,3-	542-75-6	5.5E-01	Bast and Borges, 1998	0.0E+00	default[b]
Dichlorvos	62-73-7	5.0E-01	default[a]	1.0E-01	default[b]
Dieldrin	60-57-1	5.0E-01	Bast and Borges, 1998	1.0E-01	default[b]
Diethylhexyl adipate	103-23-1	5.0E-01	default[a]	1.0E-01	default[b]
Diethyl phthalate	84-66-2	9.0E-01	Bast and Borges, 1998	1.0E-01	default[b]
Diethylstilbestrol	56-53-1	5.0E-01	default[a]	1.0E-01	default[b]
Dimethoate	60-51-5	5.0E-01	default[a]	1.0E-01	default[b]
Dimethoxybenzidine, 3,3'-	119-90-4	5.0E-01	default[a]	1.0E-01	default[b]
Dimethylbenzidine, 3,3'-	119-93-7	5.0E-01	default[a]	1.0E-01	default[b]
Dimethyl phenol, 2,4-	105-67-9	5.0E-01	default[a]	1.0E-01	default[b]
Dinitrobenzene, 1,3-	99-65-0	6.5E-01	Bast and Borges, 1998	1.0E-01	default[b]
Dinitrobenzene, 1,4-	100-25-4	5.0E-01	default[a]	1.0E-01	default[b]
Dinitrophenol, 2,4-	51-28-5	1.0E+00	Bast and Borges, 1998	1.0E-01	default[b]
Dinitrotoluene, 2,4-	121-14-2	8.5E-01	Bast and Borges, 1998	1.0E-01	default[b]
Dinitrotoluene, 2,6-	606-20-2	8.5E-01	Bast and Borges, 1998	1.0E-01	default[b]
Dinoseb	88-85-7	5.0E-01	default[a]	1.0E-01	default[b]
Dioxane 1,4-	123-91-1	8.0E-01	default[a]	0.0E+00	default[b]
Diphenylamine	122-39-4	5.0E-01	default[a]	1.0E-01	default[b]
Diphenylhydrazine, 1,2-	122-66-7	5.0E-01	default[a]	1.0E-01	default[b]
Diquat	85-00-7	5.0E-01	default[a]	1.0E-01	default[b]
Disulfoton	298-04-4	5.0E-01	default[a]	1.0E-01	default[b]
Diuron	330-54-1	5.0E-01	default[a]	1.0E-01	default[b]
Endosulfan	115-29-7	5.0E-01	default[a]	1.0E-01	default[b]
Endothall	145-73-3	5.0E-01	default[a]	1.0E-01	default[b]

Attachment C:
Dermal and GI Absorption Factors

COC	CAS #	ABS.gi (unitless)	Reference	ABS.d (unitless)	Reference
Endrin	72-20-8	2.0E-02	Bast and Borges, 1998	1.0E-01	default[b]
Epichlorohydrin	106-89-8	8.0E-01	default[a]	0.0E+00	default[b]
Ethion	563-12-2	5.0E-01	default[a]	1.0E-01	default[b]
Ethoxy ethanol, 2-	110-80-5	8.0E-01	default[a]	0.0E+00	default[b]
Ethyl acetate	141-78-6	8.0E-01	default[a]	0.0E+00	default[b]
Ethyl acrylate	140-88-5	8.0E-01	default[a]	0.0E+00	default[b]
Ethyl benzene	100-41-4	9.7E-01	Bast and Borges, 1998	0.0E+00	default[b]
Ethyl dipropylthiocarbamate, S-	759-94-4	5.0E-01	default[a]	1.0E-01	default[b]
Ethyl ether	60-29-7	8.0E-01	default[a]	0.0E+00	default[b]
Ethyl methacrylate	97-63-2	8.0E-01	default[a]	0.0E+00	default[b]
Ethyl-2-methyl benzene, 1-	611-14-3	9.7E-01	Bast and Borges, 1998	0.0E+00	default[b]
Ethyl-4-methyl benzene, 1-	622-96-8	9.7E-01	Bast and Borges, 1998	0.0E+00	default[b]
Ethylenediamine	107-15-3	8.0E-01	default[a]	0.0E+00	default[b]
Ethylene dibromide	106-93-4	8.0E-01	default[a]	0.0E+00	default[b]
Ethylene glycol	107-21-1	5.0E-01	default[a]	1.0E-01	default[b]
Ethylene oxide	75-21-8	8.0E-01	default[a]	0.0E+00	default[b]
Ethylene thiourea	96-45-7	5.0E-01	default[a]	1.0E-01	default[b]
Fluoranthene	206-44-0	8.9E-01	Hecht, 1979	1.3E-01	Wester *et al*., 1990
Fluorene	86-73-7	8.9E-01	Hecht, 1979	1.3E-01	Wester *et al*., 1990
Fluorine (soluble fluoride)	7782-41-4	9.7E-01	Bast and Borges, 1998	1.0E-02	default[b]
Formaldehyde	50-00-0	8.0E-01	default[a]	0.0E+00	default[b]
Formic acid	64-18-6	8.0E-01	default[a]	0.0E+00	default[b]
Furan	110-00-9	8.0E-01	default[a]	0.0E+00	default[b]
Furfural	98-01-1	8.0E-01	default[a]	0.0E+00	default[b]
Glycidylaldehyde	765-34-4	8.0E-01	default[a]	0.0E+00	default[b]

Attachment C:
Dermal and GI Absorption Factors

COC	CAS #	ABS.gi (unitless)	Reference	ABS.d (unitless)	Reference
Heptachlor	76-44-8	7.2E-01	Bast and Borges, 1998	1.0E-01	default[b]
Heptachlor epoxide	1024-57-3	7.2E-01	Bast and Borges, 1998	1.0E-01	default[b]
Hexachlorobenzene	118-74-1	5.0E-01	default[a]	1.0E-01	default[b]
Hexachlorobutadiene	87-68-3	5.0E-01	default[a]	1.0E-01	default[b]
Hexachlorocyclohexane, alpha	319-84-6	9.7E-01	Bast and Borges, 1998	1.0E-01	default[b]
Hexachlorocyclohexane, beta	319-85-7	9.1E-01	Bast and Borges, 1998	1.0E-01	default[b]
Hexachlorocyclohexane, gamma	58-89-9	9.7E-01	Bast and Borges, 1998	4.0E-02	Duff and Kissel, 1996
Hexachlorocyclohexane, techn	608-73-1	9.7E-01	Bast and Borges, 1998	1.0E-01	default[b]
Hexachlorocyclopentadiene	77-47-4	5.0E-01	default[a]	1.0E-01	default[b]
Hexachloroethane	67-72-1	5.0E-01	default[a]	1.0E-01	default[b]
Hexachlorophene	70-30-4	5.0E-01	default[a]	1.0E-01	default[b]
Hexane, n-	110-54-3	8.0E-01	Bast and Borges, 1998	0.0E+00	default[b]
Hexazinone	51235-04-2	5.0E-01	default[a]	1.0E-01	default[b]
Hydrazine	302-01-2	8.0E-01	default[a]	0.0E+00	default[b]
Indeno-1,2,3-cd-pyrene	193-39-5	8.9E-01	Hecht, 1979	1.3E-01	Wester *et al*., 1990
Isobutyl alcohol	78-83-1	8.0E-01	default[a]	0.0E+00	default[b]
Isophorone	78-59-1	5.0E-01	default[a]	1.0E-01	default[b]
Kepone	143-50-0	5.0E-01	default[a]	1.0E-01	default[b]
Malathion	121-75-5	5.0E-01	default[a]	1.0E-01	default[b]
Maleic anhydride	108-31-6	5.0E-01	default[a]	1.0E-01	default[b]
Maleic hydrazide	123-33-1	5.0E-01	default[a]	1.0E-01	default[b]
Malononitrile	109-77-3	5.0E-01	default[a]	1.0E-01	default[b]
Manganese	7439-96-5	6.0E-02	Ruoff, 1995	1.0E-02	default[b]
Mercury	7439-97-6	7.0E-02	IRIS, 1997	1.0E-02	default[b]
Methacrylonitrile	126-98-7	8.0E-01	default[a]	0.0E+00	default[b]

Attachment C:
Dermal and GI Absorption Factors

COC	CAS #	ABS.gi (unitless)	Reference	ABS.d (unitless)	Reference
Methanol	67-56-1	8.0E-01	default[a]	0.0E+00	default[b]
Methomyl	16752-77-5	5.0E-01	default[a]	1.0E-01	default[b]
Methoxychlor	72-43-5	5.0E-01	default[a]	1.0E-01	default[b]
Methoxyethanol, 2-	109-86-4	8.0E-01	default[a]	0.0E+00	default[b]
Methyl ethyl ketone	78-93-3	8.0E-01	Bast and Borges, 1998	0.0E+00	default[b]
Methyl isobutyl ketone	108-10-1	8.0E-01	Bast and Borges, 1998	0.0E+00	default[b]
Methyl mercury	22967-92-6	9.0E-01	Bast and Borges, 1998	1.0E-02	default[b]
Methyl methacrylate	80-62-6	8.0E-01	default[a]	0.0E+00	default[b]
Methylnaphthalene, 2-	91-57-6	8.9E-01	Hecht, 1979	1.3E-01	Wester *et al*., 1990
Methyl parathion	298-00-0	5.0E-01	default[a]	1.0E-01	default[b]
Methylene-bis (2-chloroaniline) 4,4'-	101-14-4	5.0E-01	default[a]	1.0E-01	default[b]
Methylene chloride	75-09-2	9.5E-01	Bast and Borges, 1998	0.0E+00	default[b]
Molinate	2212-67-1	5.0E-01	default[a]	1.0E-01	default[b]
Molybdenum	7439-98-7	3.8E-01	Bast and Borges, 1998	1.0E-02	default[b]
Naled	300-76-5	5.0E-01	default[a]	1.0E-01	default[b]
Naphthalene	91-20-3	8.9E-01	Hecht, 1979	1.3E-01	Wester *et al*., 1990
Nickel and compounds (soluble salts)	7440-02-0	4.0E-02	Elakhovskay, 1972	1.0E-02	default[b]
Nitrate	14797-55-8	5.0E-01	Bast and Borges, 1998	1.0E-02	default[b]
Nitrite	14797-65-0	5.0E-01	Bast and Borges, 1998	1.0E-02	default[b]
Nitroaniline, 2-	88-74-4	5.0E-01	default[a]	1.0E-01	default[b]
Nitrobenzene	98-95-3	9.7E-01	Bast and Borges, 1998	1.0E-01	default[b]
Nitropropane, 2-	79-46-9	8.0E-01	default[a]	0.0E+00	default[b]
Nitroso-n-ethylurea, n-	759-73-9	5.0E-01	default[a]	1.0E-01	default[b]
Nitroso-methyl-ethyl-amine, n-	10595-95-6	8.0E-01	default[a]	0.0E+00	default[b]
Nitrosodi-n-butylamine, n-	924-16-3	5.0E-01	default[a]	1.0E-01	default[b]

Attachment C:
Dermal and GI Absorption Factors

COC	CAS #	ABS.gi (unitless)	Reference	ABS.d (unitless)	Reference
Nitrosodi-n-propylamine, n-	621-64-7	2.5E-01	Bast and Borges, 1998	1.0E-01	default[b]
Nitrosodiethanolamine	1116-54-7	5.0E-01	default[a]	1.0E-01	default[b]
Nitrosodiethylamine, n-	55-18-5	8.0E-01	default[a]	0.0E+00	default[b]
Nitrosodimethylamine, n-	62-75-9	8.0E-01	default[a]	0.0E+00	default[b]
Nitrosodiphenylamine	86-30-6	2.5E-01	Bast and Borges, 1998	1.0E-01	default[b]
Nitrosopyrrolidine, n-	930-55-2	5.0E-01	default[a]	1.0E-01	default[b]
Nitrotoluene, m-	99-08-1	5.0E-01	default[a]	1.0E-01	default[b]
Nitrotoluene, o-	88-72-2	5.0E-01	default[a]	1.0E-01	default[b]
Nitrotoluene, p-	99-99-0	5.0E-01	default[a]	1.0E-01	default[b]
Octamethylpyrophosphoramide	152-16-9	5.0E-01	default[a]	1.0E-01	default[b]
Oxamyl	23135-22-0	5.0E-01	default[a]	1.0E-01	default[b]
Parathion	56-38-2	5.0E-01	default[a]	1.0E-01	default[b]
Pebulate	1114-71-2	5.0E-01	default[a]	1.0E-01	default[b]
Pentachlorobenzene	608-93-5	5.0E-01	default[a]	1.0E-01	default[b]
Pentachloronitrobenzene	82-68-8	5.0E-01	default[a]	1.0E-01	default[b]
Pentachlorophenol	87-86-5	7.6E-01	Korte, 1978	2.5E-01	Wester *et al*., 1993b
Phenanthrene	85-01-8	8.9E-01	Hecht, 1979	1.3E-01	Wester *et al*., 1990
Phenol	108-95-2	9.0E-01	Bast and Borges, 1998	1.0E-01	default[b]
Phenyl mercuric acetate	62-38-4	5.0E-01	default[a]	1.0E-01	default[b]
Phenylene diamine, m-	108-45-2	5.0E-01	default[a]	1.0E-01	default[b]
Phenylene diamine, p-	106-50-3	5.0E-01	default[a]	1.0E-01	default[b]
Phorate	298-02-2	5.0E-01	default[a]	1.0E-01	default[b]
Phosphine	7803-51-2	2.0E-01	default[a]	1.0E-02	default[b]
Phosphorus, white	7723-14-0	2.0E-01	default[a]	1.0E-02	default[b]
Phthalic anhydride	85-44-9	5.0E-01	default[a]	1.0E-01	default[b]

Attachment C:
Dermal and GI Absorption Factors

COC	CAS #	ABS.gi (unitless)	Reference	ABS.d (unitless)	Reference
Polybrominated biphenyls	67774-32-7	9.3E-01	Bast and Borges, 1998	1.0E-01	default[b]
Pronamide	23950-58-5	5.0E-01	default[a]	1.0E-01	default[b]
Propargite	2312-35-8	5.0E-01	default[a]	1.0E-01	default[b]
Propargyl alcohol	107-19-7	8.0E-01	default[a]	0.0E+00	default[b]
Propham	122-42-9	5.0E-01	default[a]	1.0E-01	default[b]
Propylene oxide	75-56-9	8.0E-01	default[a]	0.0E+00	default[b]
Pyrene	129-00-0	8.9E-01	Hecht, 1979	1.3E-01	Wester *et al*., 1990
Pyridine	110-86-1	8.0E-01	default[a]	0.0E+00	default[b]
Quinoline	91-22-5	5.0E-01	default[a]	1.0E-01	default[b]
Selenium	7782-49-2	>5.0E-01	Young, 1982	1.0E-02	default[b]
Selenourea	630-10-4	---	---	---	default[b]
Silver	7440-22-4	4.0E-02	IRIS, 1998	1.0E-02	default[b]
Sodium diethyldithiocarbamate	148-18-5	---	---	---	default[b]
Strychnine	57-24-9	5.0E-01	default[a]	1.0E-01	default[b]
Styrene	100-42-5	8.0E-01	default[a]	0.0E+00	default[b]
Tetrachlorobenzene, 1,2,4,5-	95-94-3	5.0E-01	default[a]	1.0E-01	default[b]
Tetrachloroethane, 1,1,1,2-	630-20-6	8.0E-01	default[a]	0.0E+00	default[b]
Tetrachloroethane, 1,1,2,2-	79-34-5	7.0E-01	Bast and Borges, 1998	0.0E+00	default[b]
Tetrachloroethylene	127-18-4	1.0E+00	Bast and Borges, 1998	0.0E+00	default[b]
Tetrachlorophenol, 2,3,4,6-	58-90-2	5.0E-01	default[a]	1.0E-01	default[b]
Tetraethyl dithiopyrophosphate	3689-24-5	5.0E-01	default[a]	1.0E-01	default[b]
Tetraethyl lead	78-00-2	5.0E-01	default[a]	1.0E-01	default[b]
Thallium and compounds (as thallium chloride)	7791-12-0	1.0E+00	Lie, 1960	1.0E-02	default[b]
Thiofanox	39196-18-4	5.0E-01	default[a]	1.0E-01	default[b]

Attachment C:
Dermal and GI Absorption Factors

COC	CAS #	ABS.gi (unitless)	Reference	ABS.d (unitless)	Reference
Thiophanate-methyl	23564-05-8	5.0E-01	default[a]	1.0E-01	default[b]
Thiram	137-26-8	5.0E-01	default[a]	1.0E-01	default[b]
Tin	7440-31-5	1.0E-01	Bast and Borges, 1998	1.0E-02	default[b]
Toluene	108-88-3	8.0E-01	Bast and Borges, 1998	0.0E+00	default[b]
Toluenediamine, 2,4-	95-80-7	5.0E-01	default[a]	1.0E-01	default[b]
Toluenediamine, 2,6-	823-40-5	5.0E-01	default[a]	1.0E-01	default[b]
Toluene diisocyanate, 2,4/2,6-	26471-62-5	5.0E-01	default[a]	1.0E-01	default[b]
Toluidine, p-	106-49-0	5.0E-01	default[a]	1.0E-01	default[b]
Toxaphene	8001-35-2	5.0E-01	default[a]	1.0E-01	default[b]
TP Silvex, 2,4,5-	93-72-1	5.0E-01	default[a]	1.0E-01	default[b]
Triallate	2303-17-5	5.0E-01	default[a]	1.0E-01	default[b]
Tributyltin oxide	56-35-9	5.0E-01	default[a]	1.0E-01	default[b]
Trichloro-1,2,2-trifluoroethane, 1,1,2-	76-13-1	8.0E-01	default[a]	0.0E+00	default[b]
Trichlorobenzene, 1,2,4-	120-82-1	9.7E-01	Bast and Borges, 1998	1.0E-01	default[b]
Trichloroethane, 1,1,1-	71-55-6	9.0E-01	Bast and Borges, 1998	0.0E+00	default[b]
Trichloroethane, 1,1,2-	79-00-5	8.1E-01	Bast and Borges, 1998	0.0E+00	default[b]
Trichloroethylene	79-01-6	1.0E+00	Dekant *et al.*, 1986; Green and Prout, 1985; Lee *et al.*, 1997	0.0E+00	default[b]
Trichlorofluoromethane	75-69-4	2.3E-01	Bast and Borges, 1998	0.0E+00	default[b]
Trichlorophenol, 2,4,5-	95-95-4	5.0E-01	default[a]	1.0E-01	default[b]
Trichlorophenol, 2,4,6-	88-06-2	5.0E-01	default[a]	1.0E-01	default[b]
Trichlorophenoxyacetic acid, 2,4,5-	93-76-5	5.0E-01	default[a]	1.0E-01	default[b]
Trichloropropane, 1,1,2-	598-77-6	8.0E-01	default[a]	0.0E+00	default[b]
Trichloropropane, 1,2,3-	96-18-4	8.0E-01	default[a]	0.0E+00	default[b]

Attachment C: Dermal and GI Absorption Factors					
COC	CAS #	ABS.gi (unitless)	Reference	ABS.d (unitless)	Reference
Triethylamine	121-44-8	8.0E-01	default[a]	0.0E+00	default[b]
Trifluralin	1582-09-8	5.0E-01	default[a]	1.0E-01	default[b]
Trimethylbenzene, 1,2,3-	526-73-8	9.7E-01	Bast and Borges, 1998	0.0E+00	default[b]
Trinitrobenzene, 1,3,5-	99-35-4	6.5E-01	Bast and Borges, 1998	1.0E-01	default[b]
Trinitrophenylmethylnitramine	479-45-8	5.0E-01	Bast and Borges, 1998	1.0E-01	default[b]
Trinitrotoluene, 2,4,6-	118-96-7	6.0E-01	Bast and Borges, 1998	1.0E-01	default[b]
Uranium	7440-61-1	8.5E-01	Bast and Borges, 1998	1.0E-02	default[b]
Vanadium	7440-62-2	2.6E-02	Conklin, 1982	1.0E-02	default[b]
Vernam	1929-77-7	5.0E-01	default[a]	1.0E-01	default[b]
Vinyl acetate	108-05-4	6.5E-01	Bast and Borges, 1998	0.0E+00	default[b]
Vinyl chloride	75-01-4	1.0E+00	Bast and Borges, 1998	0.0E+00	default[b]
Warfarin	81-81-2	5.0E-01	default[a]	1.0E-01	default[b]
Xylene, m-	108-38-3	8.0E-01	default[a]	0.0E+00	default[b]
Xylene, o-	95-47-6	8.0E-01	default[a]	0.0E+00	default[b]
Xylene, p-	106-42-3	8.0E-01	default[a]	0.0E+00	default[b]
Xylenes	1330-20-7	9.2E-01	Bast and Borges, 1998	0.0E+00	default[b]
Zinc	7440-66-6	2.0E-01	Bast and Borges, 1998	1.0E-02	default[b]

a: 80% for volatile organics; 50% for semi-volatile organics and non-volatile organics; 20% for inorganics. USEPA, 1995,*Supplemental Guidance to RAGS: Region IV Bulletins, Human Health Assessment* , Waste Management Division, Atlanta, GA, November.

b: 0% for volatile organics; 10% for semi-volatile organics and non-volatile organics; 1% for inorganics. USEPA Dermal Workgroup, 1996.

ABS.d/ABS.gi references

Bast, C.B. and Borges H.T., 1998, Derivation of Toxicity Values for Dermal Exposure,*The Toxicologist*, Vol. 31, No. 1, Part 2, March, 1996 (original abstract published in 1996; updated in January, 1998), Oak Ridge National Laboratory, Nashville, TN.

Conklin, A.W., Skinner, S.C., Felten, T.L., and Sanders, C.L., 1982. *Toxicol. Lett*. 11:199-203.

Cuddihy, R.G. and Griffith, W.C., 1972. A Biological Model Describing Tissue Distribution and Whole-body Retention of Barium and Lanthanum in Beagle Dogs after Inhalation and Gavage,*Health Phys*. 23:621-633.

Dekant, W., Schulz, A., Metzler, M., and Henschler, D., 1986. Absorption, elimination and metabolism of trichloroethylene: A quantitative comparison between rats and mice,*Xenobiotica* 16:143-152.

Donaldson, R.M. and Barreras, R.F. Intestinal Absorption of Trace Quantities of Chromium,*J. Lab. Clin. Med*. 68:484-493, 1966.

Duff, R.M. and Kissel, J.C., (1996). Effect of Soil Loading on Dermal Absorption Efficiency from Contaminated Soils,*J. Tox. Environ. Health*, 48:93-106.

Elakhovskaya, N.P., 1972. The Metabolism of Nickel Entering the Organism with Water (Russian translation),*Gig Sanit* 6:20-22.

Ewing, K.J., Morgan, W.D., Zanzi, I. et al., 1979. In Vivo Measurement in Smokers and Nonsmokers,*Science* 205:323-325.

Farooqui, M.Y.H. and Ahmed, A.E., 1982. Molecular Interaction of Acrylonitrile and Potassium Cyanide with Rat Blood,*Chem. Biol. Interact*. 38:145-159.

Green, T. and Prout, M.S., 1985. Species differences in response to trichloroethylene,*Toxicol. Appl. Pharmacol*., 79:401-411.

Hecht, S.S., Grabowski, W., Groth, K., 1979. Analysis of Faeces for Benzo[a]pyrene after Consumption of Charcoal-broiled Beef by Rats and Humans, *Cosmet. Toxicology* 17:223-227.

Integrated Risk Information System (IRIS), online, 1997, 1998. USEPA National Center for Environmental Assessment.

Keller, W. and Yeary, R., 1980. A Comparison of the Effects of Mineral Oil, Vegetable Oil, and Sodium Sulfate on the Intestinal Absorption of DDT in Rodents, *Clin Toxicol*. 16:223-231.

Knopp, D. and Schiller, F., 1992. Oral and Dermal Application of 2,4-dichlorophenoxyacetic Acid Sodium and Dimethylamine Salts to Male Rats:

Investigations on Absorption and Excretion as Well as Induction of Hepatic Mixed-function Oxidase Activities,*Arch. Toxicol*. 66:170-174.

Korte, F., 1978. Ecotoxicologic Profile Analysis,*Chemisphere* 1:79-102.

Lee, K.M., Muralidhara, S., Dallas, C.E., and Bruckner, J.V, 1997. Lack of volatilization and escape of orally administered trichloroethylene from the gastrointestinal track of rats,*Toxicol. Indust. Health* , 13:81-89.

Lie, R., Thomas, R.G., and Scot, J.K., 1960. The Distribution and Excretion of Thallium^{204} in the Rat: Suggested MPCs and a Bioassay Procedure, *Health Phys*. 2:334-340.

MacKenzie, R.D., Anwar, R.A., Byerrum, R.U., and Hoppert, C.A., 1959. Absorption and Distribution of Cr^{51} in the Albino Rat,*Arch. Biochem. Biophys*. 79:200-205.

Ohno, Y., Kawanishi, T., Takahashi, A., 1986. Comparisons of the Toxicokinetic Parameters in Rats Determined for Low and High Dose Gamma-chlordane, *J. Toxicol. Sci* , 11:111-124.

Pelletier, O., Ritter, L., and Somers, C.J., 1989. Disposition of 2,4-Dichlorophenoxyacetic Acid Dimethylamine by Fischer 344 Rats Dosed Orally and Dermally, *J. Toxicol. Environ. Health* 28:221-234.

Reeves, A.L., 1965. The Absorption of Beryllium from the Gastrointestinal Tract,*Arch. Environ. Health* 11:209-214

Ruoff, W. 1995. Relative Bioavailability of Manganese Ingested in Food or Water, Proceedings Workshop on the Bioavailability and Oral Toxicity of Manganese, USEPA-ECAO, Cincinnati, OH.

Sayato, Y., Nakamuro, K., Matsui, S., Ando, M., 1980. Metabolic Fate of Chromium Compounds. I.. Comparative Behavior of Chromium in Rat Administered with $Na_2{}^{51}CrO_4$ and $^{51}CrCl_3$, *J. Pharm. Dyn*. 3:17-23.

Strickland, G.T., Beckner, W.M., and Leu, M.L., 1972. *Clin. Sci*. 43:617-625.

Taylor, D.M., Bligh, P.H., and Duggan, M.H., 1962. The Absorption of Calcium, Strontium, Barium, and Radium from the Gastrointestinal Tract of the Rat, *Biochem. J*. 83:25-29.

USEPA, 1992e. Dermal Exposure Assessment: Principles and Applications. EPA/600/8-91/011B, 1992.

Waitz, J.A., Ober, R.E., Meisenhelder, J.E., and Thompson, P.E., 1965. *WHO Bulletin* 33:357-546.

Wester, R.C., Maibach, H.I., Sedik, L., Melendres, J., DiZio, S., Wade, M., 1992a. *In Vitro* Percutaneous Absorption of Cadmium From Water and Soil Into Human Skin, *Fund. Appl. Toxicol.* 19:1-5.

Wester, R.C., Maibach, H.I., Bucks, D.A.W., Sedik, L., Melendres, J., Liao, C., DiZio, S., 1990. Percutaneous Absorption of [^{4}C]DDT and [^{14}C]Benzo[a]pyrene from Soil, *Fund. Appl. Toxicol*. 15:510-516.

Wester, R.C., Maibach, H.I., Sedik, L., Melendres, J., Liao, C., DiZio, S., 1992b. Percutaneous Absorption of [14C] Chlordane from Soil, *J. Toxicol. Environ. Health* 35:269-77.

Wester, R.C., Maibach, H.I., Sedik, L., Melendres, J., Wade, M., DiZio, S., 1993b. Percutaneous Absorption of Pentachlorophenol From Soil, *Fund. Appl. Toxicol*. 20:68-71.

Wester, R.C., Melendres, J., Logan, F., Hui, X., Maibach, H.I., Wade, M., Huang, K-C, 1996. Percutaneous Absorption of 2,4-Dichlorophenoxyacetic Acid From Soil With Respect to Soil Load and Skin Contact Time: *In Vivo* Absorption in Rhesus Monkey and *In Vitro* Absorption in Human Skin, *J. Toxicol. Environ. Health* 47:335-344.

Young, V.R., Nahapetian, A., Janghorbani, M., 1982. Selenium Bioavailability with Reference to Human Nutrition, *Am. J. Clin. Nutr*. 35:1076-1088.

XI. REFERENCES

Bast, C.B. and Borges H.T., 1998, Derivation of Toxicity Values for Dermal Exposure, *The Toxicologist*, Vol. 31, No. 1, Part 2, March, 1996 (original abstract published in 1996; updated in January, 1998), Oak Ridge National Laboratory, Nashville, TN.

California Environmental Protection Agency (CalEPA), 1994. *Preliminary Endangerment Assessment Guidance Manual*, Department of Toxic Substances Control.

Conklin, A.W., Skinner, S.C., Felten, T.L., and Sanders, C.L., 1982. *Toxicol. Lett*. 11:199-203.

Cuddihy, R.G. and Griffith, W.C., 1972. A Biological Model Describing Tissue Distribution and Whole-body Retention of Barium and Lanthanum in Beagle Dogs after Inhalation and Gavage, *Health Phys*. 23:621-633.

Dekant, W., Schulz, A., Metzler, M., and Henschler, D., 1986. Absorption, elimination and metabolism of trichloroethylene: A quantitative comparison between rats and mice, *Xenobiotica* 16:143-152.

Donaldson, R.M. and Barreras, R.F. Intestinal Absorption of Trace Quantities of Chromium, *J. Lab. Clin. Med*. 68:484-493, 1966.

Duff, R.M. and Kissel, J.C., (1996). Effect of Soil Loading on Dermal Absorption Efficiency from Contaminated Soils, *J. Tox. Environ. Health*, 48:93-106.

Elakhovskaya, N.P., 1972. The Metabolism of Nickel Entering the Organism with Water (Russian translation), *Gig Sanit* 6:20-22.

Ewing, K.J., Morgan, W.D., Zanzi, I. et al., 1979. In Vivo Measurement in Smokers and Nonsmokers, *Science* 205:323-325.

Farooqui, M.Y.H. and Ahmed, A.E., 1982. Molecular Interaction of Acrylonitrile and Potassium Cyanide with Rat Blood, *Chem. Biol. Interact*. 38:145-159.

Gilbert, R.O. 1987. *Statistical Methods for Environmental Pollution Monitoring*. Van Nostrand Reinhold Company, New York. pp.177-185.

Green, T. and Prout, M.S., 1985. Species differences in response to trichloroethylene, *Toxicol. Appl. Pharmacol*., 79:401-411.

Hecht, S.S., Grabowski, W., Groth, K., 1979. Analysis of Faeces for Benzo[a]pyrene after Consumption of Charcoal-broiled Beef by Rats and Humans, *Cosmet. Toxicology* 17:223-227.

Keller, W. and Yeary, R., 1980. A Comparison of the Effects of Mineral Oil, Vegetable Oil, and Sodium Sulfate on the Intestinal Absorption of DDT in Rodents, *Clin Toxicol*. 16:223-231.

Korte, F., 1978. Ecotoxicologic Profile Analysis, *Chemisphere* 1:79-102.

Integrated Risk Information System (IRIS), online, 1997, 1998. USEPA National Center for Environmental Assessment.

Institute of Medicine, (IOM), 1994. Committee to Review the Health Effects in Vietnam Veterans of Exposure to Herbicides, *Veterans and Agent Orange: Health Effects of Herbicides Used in Vietnam*, National Academy Press, Washington, D.C., p. 175.

Knopp, D. and Schiller, F., 1992. Oral and Dermal Application of 2,4-dichlorophenoxyacetic Acid Sodium and Dimethylamine Salts to Male Rats:

Investigations on Absorption and Excretion as Well as Induction of Hepatic Mixed-function Oxidase Activities,*Arch. Toxicol*. 66:170-174.

Lee, K.M., Muralidhara, S., Dallas, C.E., and Bruckner, J.V, 1997. Lack of volatilization and escape of orally administered trichloroethylene from the gastrointestinal track of rats, *Toxicol. Indust. Health* , 13:81-89.

Lie, R., Thomas, R.G., and Scot, J.K., 1960. The Distribution and Excretion of Thallium^{204} in the Rat: Suggested MPCs and a Bioassay Procedure, *Health Phys*. 2:334-340.

MacKenzie, R.D., Anwar, R.A., Byerrum, R.U., and Hoppert, C.A., 1959. Absorption and Distribution of Cr^{51} in the Albino Rat, *Arch. Biochem. Biophys*. 79:200-205.

Michael, D. I. 1992. Planning ahead to get the quality of RI data needed for remedy selection: Applying the Data Quality Objectives (DQO) process to Superfund Remedial Investigations. ???

Neptune, D., Brantly, E., Messner, M., and D. Micheal. "Quantitative Decision Making in Superfund",*Hazardous Materials Control* , May-June 1990, Vol. 3-3.

Ohno, Y., Kawanishi, T., Takahashi, A., 1986. Comparisons of the Toxicokinetic Parameters in Rats Determined for Low and High Dose Gamma-chlordane, *J. Toxicol. Sci* , 11:111-124.

Pelletier, O., Ritter, L., and Somers, C.J., 1989. Disposition of 2,4-Dichlorophenoxyacetic Acid Dimethylamine by Fischer 344 Rats Dosed Orally and Dermally, *J. Toxicol. Environ. Health* 28:221-234.

Sayato, Y., Nakamuro, K., Matsui, S., Ando, M., 1980. Metabolic Fate of Chromium Compounds. I.. Comparative Behavior of Chromium in Rat Administered with $Na_2{}^{51}CrO_4$ and $^{51}CrCl_3$, *J. Pharm. Dyn*. 3:17-23.

Reeves, A.L., 1965. The Absorption of Beryllium from the Gastrointestinal Tract,*Arch. Environ. Health* 11:209-214.

Ruoff, W. 1995. Relative Bioavailability of Manganese Ingested in Food or Water, Proceedings Workshop on the Bioavailability and Oral Toxicity of Manganese, USEPA-ECAO, Cincinnati, OH.

Strickland, G.T., Beckner, W.M., and Leu, M.L., 1972. *Clin. Sci*. 43:617-625.

Tanabe, S., 1981. Absorption Efficiencies and Biological Half-life of Individual Chlorobiphenyls in Rats Treated with Kanechlor Products,*Agric. Biol. Chem*. 45:717-726.

Taylor, D.M., Bligh, P.H., and Duggan, M.H., 1962. The Absorption of Calcium, Strontium, Barium, and Radium from the Gastrointestinal Tract of the Rat, *Biochem. J*. 83:25-29.

USEPA, 1989a. Risk Assessment Guidance Document for Superfund, Vol. I, Human Health Evaluation Manual (Part A), Interim Final. EPA/540/1-89/002.

USEPA, 1989b. Methods for Evaluating the Attainment of Cleanup Standards, Vol. 1: Soils and Solid Media. EPA 230/02-89-042. February, 1989.

USEPA, 1991. Exposure Point Concentrations in Groundwater, EPA/903/8-91/002, Region III, Office of Superfund, Hazardous Waste Management, November 1991.

USEPA, 1992a. Guidance for Data Useability in Risk Assessment (Part A), Final. 9285.7-09A

USEPA, 1992b. Supplemental Guidance to RAGS: Calculating the Concentration Term.
PB92-963373.

USEPA, 1992c. Draft Guidance on the Selection of Analytical Metal Results from Monitoring Well Samples for Use in the Quantitative Estimation of Risk. August, 1992.

USEPA, 1992d. Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Draft Addendum to Interim Final Guidance. July, 1992.

USEPA, 1992e. Dermal Exposure Assessment: Principles and Applications. EPA/600/8-91/011B, 1992.

USEPA, 1992f. Control of Air Emissions from Superfund Sites. EPA/625/R-92/012. November, 1992.

USEPA, 1992g. Memorandum: Guidance on Risk Characterization for Risk Managers and Risk Assessors: F. Henry Habicht II, Deputy Administrator, Washington, D.C.

USEPA, 1994a. Region 8 Superfund Technical Guidance. SOP#RA-03. January, 1994.

USEPA, 1994b. USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review. PB94-963502. EPA 540/R-94/013. February, 1994.

USEPA, 1994c. USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review. PB94-963501. EPA 540/R-94/012. February, 1994.

USEPA, 1995. Supplemental Guidance to RAGS: Region 4 Bulletins Human Health Risk Assessment, Interim. November, 1995.

USEPA, 1996a. Guidance for Data Quality Assessment. EPA/600/R-96/084. July 1996.

USEPA, 1996b. Low-Flow (Minimal Drawdown) Groundwater Sampling Procedures. EPA/540/S-95/504. April 1996.

USEPA, 1997a. Health Effects Assessment Summary Tables (HEAST), FY 1997 Update. Office of Solid Waste and Emergency Response. EPA-540-R-97-036, PB97-921199, July 1997.

USEPA, 1997b. Exposure Factors Handbook, Vol. I. EPA/600/P-95/002Fa. August, 1997.

Waitz, J.A., Ober, R.E., Meisenhelder, J.E., and Thompson, P.E., 1965. *WHO Bulletin* 33:357-546.

Wester, R.C., Maibach, H.I., Bucks, D.A.W., Sedik, L., Melendres, J., Liao, C., DiZio, S., 1990. Percutaneous Absorption of [^{4}C]DDT and [^{14}C]Benzo[a]pyrene from Soil, *Fund. Appl. Toxicol* . 15:510-516.

Wester, R.C., Maibach, H.I., Sedik, L., Melendres, J., DiZio, S., Wade, M., 1992a. *In Vitro* Percutaneous Absorption of Cadmium From Water and Soil Into Human Skin, *Fund. Appl. Toxicol.* 19:1-5.

Wester, R.C., Maibach, H.I., Sedik, L., Melendres, J., Liao, C., DiZio, S., 1992b. Percutaneous Absorption of [14C] Chlordane from Soil, *J. Toxicol. Environ. Health* 35:269-77.

Wester, R.C., Maibach, H.I., Sedik, L., Melendres, J., Wade, M., 1993a. Percutaneous Absorption of PCBs From Soil: *In Vivo* Rhesus Monkey, *In Vitro* Human Skin, and Binding to Powdered Human Stratum Corneum, *J. Toxicol. Environ. Health* 39:375-82.

Wester, R.C., Maibach, H.I., Sedik, L., Melendres, J., Wade, M., DiZio, S., 1993b. Percutaneous Absorption of Pentachlorophenol From Soil, *Fund. Appl. Toxicol* . 20:68-71.

Wester, R.C., Melendres, J., Logan, F., Hui, X., Maibach, H.I., Wade, M., Huang, K-C, 1996. Percutaneous Absorption of 2,4-Dichlorophenoxyacetic Acid From Soil With Respect to Soil Load and Skin Contact Time: *In Vivo* Absorption in Rhesus Monkey and *In Vitro* Absorption in Human Skin, *J. Toxicol. Environ. Health* 47:335-344.

Young, V.R., Nahapetian, A., Janghorbani, M., 1982. Selenium Bioavailability with Reference to Human Nutrition, *Am. J. Clin. Nutr* . 35:1076-1088.

Attachment E:
Chemical/Physical Properties

Chemical of Concern	CAS	Type	MW *(g/mole)*	H ' *(unitless)*	K_{ow} *(unitless)*	K_d *(unitless)*	D_{air} *(cm^2/s)*	D_{wat} *(cm^2/s)*	Solubility *(mg/l)*	Vapor Pressure *(mm Hg)*
Acenaphthene	83-32-9	O	154.21	6.44E-03	1.42E+04	7.96E+01	4.21E-02	7.69E-06	4.24E+00	3.75E-03
Acenaphthylene	208-96-8	O	152.20	4.74E-03	8.63E+03	1.38E+02	4.39E-02	7.07E-06	3.93E+00	2.90E-02
Acetaldehyde	75-07-0	O	44.05	2.75E-03	2.69E+00	5.25E-02	1.24E-01	1.23E-05	1.00E+06	9.00E+02
Acetone	67-64-1	O	58.08	1.61E-03	5.82E-01	1.14E-02	1.24E-01	1.14E-05	6.00E+05	2.27E+02
Acetone cyanohydrin	75-86-5	O	85.11	1.34E-04	9.24E-01	1.22E-02	8.12E-02	9.09E-06	1.83E+06	8.00E-01
Acetonitrile	75-05-8	O	41.05	1.21E-03	4.57E-01	9.35E-03	1.28E-01	1.45E-05	2.05E+05	9.00E+01
Acetophenone	98-86-2	O	120.15	4.45E-04	4.72E+01	7.26E-01	6.00E-02	8.73E-06	5.50E+03	3.95E-01
Acifluorfen, sodium	62476-59-9	O	383.64	8.31E-13	2.36E+00	2.26E+00	1.45E-02	4.40E-06	2.50E+05	9.75E-09
Acrolein	107-02-8	O	56.06	1.83E-04	7.94E-01	1.05E-02	1.05E-01	1.12E-05	2.00E+05	2.65E+02
Acrylamide	79-06-1	O	71.08	1.33E-08	1.56E-01	4.38E-03	9.70E-02	1.28E-05	2.20E+06	7.00E-03
Acrylic acid	79-10-7	O	72.06	1.32E-05	2.76E+00	2.27E-02	9.08E-02	1.06E-05	1.00E+06	3.72E+00
Acrylonitrile	107-13-1	O	53.06	4.57E-03	1.62E+00	2.19E-02	1.22E-01	1.34E-05	7.50E+04	1.10E+02
Alachlor	15972-60-8	O	269.77	8.62E-07	2.33E+03	3.80E+00	1.94E-02	5.83E-06	2.40E+02	2.20E-05
Aldicarb	116-06-3	O	190.27	5.82E-08	2.29E+01	3.16E-01	3.05E-02	7.20E-06	6.00E+03	2.90E-05
Aldicarb sulfone	1646-88-4	O	222.27	1.10E-07	2.16E-01	3.40E-02	5.55E-02	5.79E-06	8.00E+03	9.00E-05
Aldrin	309-00-2	O	364.91	7.07E-03	5.61E+06	9.57E+02	1.32E-02	4.86E-06	7.84E-02	1.67E-05
Allyl alcohol	107-18-6	O	58.08	2.08E-04	1.48E+00	6.47E-02	1.14E-01	1.10E-05	3.20E+05	2.63E+01
Allyl chloride	107-5-1	O	76.53	4.57E-01	8.56E+01	5.38E-01	9.80E-02	1.08E-05	3.40E+03	3.60E+02
Aluminum	7429-90-5	M	26.98	0.00E+00	2.13E+00	3.53E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Aminopyridine, 4-	504-24-5	O	94.12	2.44E-07	7.72E-01	9.52E-03	8.02E-02	1.08E-05	7.66E+04	2.00E-03
Ammonia	7664-41-7	I	17.03	1.36E-02	1.69E+00	6.18E-02	2.59E-01	6.93E-05	5.31E+05	7.47E+03
Aniline	62-53-3	O	93.13	5.82E-05	1.19E+01	1.82E-01	7.00E-02	8.30E-06	3.60E+04	6.69E-01
Anthracene	120-12-7	O	178.23	4.61E-03	2.21E+04	4.69E+02	3.24E-02	7.74E-06	4.34E-02	2.55E-05
Antimony	7440-36-0	M	121.75	0.00E+00	1.00E+00	4.50E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Aramite	140-57-8	O	334.86	CE	6.53E+04	1.98E+02	4.23E-02	4.45E-06	CE	1.23E-04
Arsenic	7440-38-2	M	74.92	0.00E+00	4.78E+00	2.50E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Arsine	7784-42-1	I	77.95	2.41E-01	---	---	CE	CE	2.00E+05	1.13E+04

Attachment E:
Chemical/Physical Properties

Chemical of Concern	CAS	Type	MW *(g/mole)*	H ' *(unitless)*	K_{ow} *(unitless)*	K_d *(unitless)*	D_{air} *(cm^2/s)*	D_{wat} *(cm^2/s)*	Solubility *(mg/l)*	Vapor Pressure *(mm Hg)*
Asbestos	1332-21-4	I	varies	0.00E+00	---	1.00E+05	CE	CE	0.00E+00	0.00E+00
Atrazine	1912-24-9	O	215.69	1.09E-07	6.57E+02	3.20E+00	5.64E-02	5.58E-06	3.00E+01	3.00E-07
Barium	7440-39-3	M	137.33	0.00E+00	1.00E+00	1.10E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Benzene	71-43-2	O	78.11	2.27E-01	9.84E+01	1.32E+00	8.80E-02	9.80E-06	1.77E+03	9.50E+01
Benzenethiol	108-98-5	O	110.18	1.83E-02	4.85E+02	4.18E-01	7.60E-02	8.68E-06	7.60E+02	2.40E+00
Benzidine	92-87-5	O	184.24	1.62E-09	2.19E+01	4.18E-01	3.40E-02	1.50E-05	5.20E+02	8.36E-08
Benzo-a-anthracene	56-55-3	O	228.29	1.39E-04	3.32E+05	7.10E+03	5.10E-02	9.00E-06	1.00E-02	1.54E-07
Benzo-a-pyrene	50-32-8	O	252.32	4.70E-05	1.29E+06	1.91E+04	4.30E-02	9.00E-06	1.62E-03	4.89E-09
Benzo-b-fluoranthene	205-99-2	O	252.32	4.99E-04	1.29E+06	2.40E+04	2.26E-02	5.56E-06	1.50E-03	8.06E-08
Benzo-k-fluoranthene	207-08-9	O	252.32	4.45E-07	1.29E+06	2.46E+04	2.26E-02	5.56E-06	5.50E-04	9.59E-11
Benzo-(g,h,i)-perylene	191-24-2	O	276.34	5.82E-06	4.98E+06	3.17E+04	4.90E-02	5.65E-05	2.60E-04	1.00E-10
Benzoic acid	65-85-0	OA	122.12	1.39E-05	7.49E+01	1.00E-02	5.36E-02	7.97E-06	3.50E+03	6.51E-03
Benzotrichloride	98-07-7	O	195.48	2.03E-02	7.87E+03	2.91E+01	5.91E-02	7.02E-06	1.00E+02	1.90E-01
Benzyl alcohol	100-51-6	O	108.14	1.62E-05	1.19E+01	2.40E-01	8.00E-02	8.00E-06	4.00E+04	1.06E-01
Benzyl chloride	100-44-7	O	126.59	1.66E-02	6.23E+02	3.64E+00	7.50E-02	7.80E-06	4.93E+02	1.20E+00
Beryllium	7440-41-7	M	9.01	0.00E+00	3.72E+00	2.30E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Biphenyl, 1,1-	92-52-4	O	154.21	1.25E-02	5.71E+03	1.03E+02	5.73E-02	6.71E-06	7.50E+00	2.94E-02
Bis (2-chloro-ethyl) ether	111-44-4	O	143.01	8.90E-04	3.61E+01	3.10E-01	6.92E-02	7.53E-06	1.02E+04	1.34E+00
Bis (2-chloroisopropyl) ether	108-60-1	O	171.07	4.16E-03	3.80E+02	6.32E+00	6.00E-02	6.40E-06	1.70E+03	8.50E-01
Bis (2-chloromethyl) ether	542-88-1	O	114.96	4.99E-03	3.76E+00	2.40E-02	8.32E-02	9.59E-06	3.80E+04	3.00E+01
Bis (2-ethyl-hexyl) phthalate	117-81-7	O	390.56	4.57E-04	2.46E+08	1.36E+04	3.51E-02	3.66E-06	3.00E-01	6.45E-06
Bromodichloromethane	75-27-4	O	163.83	1.32E-01	4.08E+01	1.10E+00	2.98E-02	1.06E-05	4.50E+03	5.84E+01
Bromoform	75-25-2	O	252.73	2.56E-02	6.16E+01	1.74E+00	1.49E-02	1.03E-05	3.20E+03	5.60E+00
Bromomethane	74-83-9	O	94.94	5.90E-01	1.50E+01	2.09E-01	7.28E-02	1.21E-05	1.52E+04	1.64E+03
Butadiene, 1,3-	106-99-0	O	54.09	2.61E+00	1.08E+02	2.58E+00	1.79E-01	1.02E-05	7.35E+02	2.11E+03
Butanol, n-	71-36-3	O	74.12	3.55E-04	6.93E+00	1.18E-01	8.00E-02	9.30E-06	7.47E+04	6.54E+00
Butylate	2008-41-5	O	217.38	3.50E-03	7.13E+03	2.52E+00	4.89E-02	5.14E-06	4.60E+01	1.30E-02

Attachment E:
Chemical/Physical Properties

Chemical of Concern	CAS	Type	MW *(g/mole)*	H ' *(unitless)*	K_{ow} *(unitless)*	K_d *(unitless)*	D_{air} *(cm^2/s)*	D_{wat} *(cm^2/s)*	Solubility *(mg/l)*	Vapor Pressure *(mm Hg)*
Butyl benzyl phthalate	85-68-7	O	312.37	7.94E-05	6.99E+04	2.75E+02	1.74E-02	4.83E-06	2.90E+00	1.20E-05
Cacodylic acid	75-60-5	O	138.00	0.00E+00	1.00E+00	4.80E-02	CE	CE	2.00E+06	0.00E+00
Cadmium	7440-43-9	M	112.41	0.00E+00	8.49E-01	1.50E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Captan	133-06-2	O	300.59	2.99E-04	6.98E+01	1.28E+02	1.83E-02	4.90E-06	5.00E-01	7.50E-06
Carbaryl	63-25-2	O	201.22	5.32E-07	2.23E+02	4.69E+00	2.78E-02	5.60E-06	3.00E+01	1.36E-06
Carbazole	86-74-8	O	167.21	3.38E-03	1.70E+03	4.91E+01	3.90E-02	7.03E-06	7.21E-01	2.66E-04
Carbofuran	1563-66-2	O	221.26	1.62E-07	2.00E+02	5.80E-01	5.35E-02	5.40E-06	7.00E+02	8.30E-06
Carbon disulfide	75-15-0	O	76.14	6.13E-01	8.71E+01	1.05E+00	1.04E-01	1.00E-05	2.30E+03	3.40E+02
Carbon tetrachloride	56-23-5	O	153.82	1.20E+00	2.77E+02	3.72E+00	7.80E-02	8.80E-06	8.05E+02	1.12E+02
Carbosulfan	55285-14-8	O	380.55	2.15E-05	3.73E+05	5.14E+02	3.76E-02	3.88E-06	3.00E-01	3.10E-07
Chloral	75-87-6	O	147.39	2.66E-05	1.55E+01	1.27E-01	3.85E-02	9.70E-06	8.30E+06	3.50E+01
Chlordane	57-74-9	O	409.78	2.02E-03	4.00E+06	2.40E+03	1.18E-02	4.37E-06	5.60E-02	1.00E-05
Chlorine	7782-50-5	I	70.91	2.86E+00	7.07E+00	---	1.20E-01	1.48E-05	7.00E+03	5.17E+03
Chloroanaline, p-	106-47-8	O	127.57	4.86E-05	5.25E+01	1.32E+00	4.83E-02	1.01E-05	3.90E+03	2.35E-02
Chlorobenzene	108-90-7	O	112.56	1.82E-01	4.34E+02	4.28E+00	7.30E-02	8.70E-06	5.02E+02	1.21E+01
Chlorobenzilate	510-15-6	O	325.19	3.78E-06	9.84E+03	1.60E+01	8.00E-02	8.00E-06	1.30E+01	2.20E-06
Chloro-1,3-butadiene, 2-	126-99-8	O	88.54	1.33E+00	3.35E+02	2.00E+00	1.00E-01	1.00E-05	6.30E+02	2.12E+02
Chlorodifluoromethane	75-45-6	O	86.47	1.22E+00	7.84E+00	1.22E-01	1.13E-01	1.32E-05	2.90E+03	7.83E+03
Chloroethane	75-00-3	O	64.51	2.12E-01	3.78E+01	3.56E-01	1.50E-01	1.18E-05	2.00E+04	1.20E+03
Chloroform	67-66-3	O	119.38	1.53E-01	3.32E+01	9.35E-01	1.04E-01	1.00E-05	7.92E+03	1.98E+02
Chloromethane	74-87-3	O	50.49	1.44E+00	1.22E+01	1.20E-01	1.26E-01	6.50E-06	7.25E+03	3.77E+03
Chloronaphthalene, 2-	91-58-7	O	162.62	2.54E-02	6.51E+03	1.70E+02	6.18E-02	6.98E-06	6.74E+00	1.70E-02
Chlorophenol, 2-	95-57-8	OA	128.56	7.40E-04	1.44E+02	5.72E+00	5.01E-02	9.46E-06	2.80E+04	1.42E+00
Chlorotoluene	25168-05-2	O	126.59	1.26E-02	6.23E+02	3.81E+00	7.13E-02	8.10E-06	5.00E+02	1.00E+00
Chlorpyrifos	2921-88-2	O	350.59	1.73E-04	4.55E+04	1.00E+02	4.85E-02	5.11E-06	9.00E-01	1.87E-05
Chromium (III)	16065-83-1	M	52.00	0.00E+00	1.00E+00	1.20E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Chromium (VI)	18540-29-9	M	52.00	0.00E+00	1.00E+00	1.40E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Attachment E:
Chemical/Physical Properties

Chemical of Concern	CAS	Type	MW *(g/mole)*	H ' *(unitless)*	K_{ow} *(unitless)*	K_d *(unitless)*	D_{air} *(cm^2/s)*	D_{wat} *(cm^2/s)*	Solubility *(mg/l)*	Vapor Pressure *(mm Hg)*
Chrysene	218-01-9	O	228.29	5.03E-05	3.32E+05	6.18E+03	2.48E-02	6.21E-06	2.00E-03	7.80E-09
Cobalt	7440-48-4	M	58.93	0.00E+00	1.00E+00	4.50E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Copper	7440-50-8	M	63.55	0.00E+00	2.69E-01	4.00E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cresol, m-	108-39-4	O	108.14	3.62E-05	1.15E+02	1.74E+00	7.40E-02	1.00E-05	2.30E+04	1.40E-01
Cresol, o-	95-48-7	O	108.14	6.65E-05	1.15E+02	1.95E+00	7.40E-02	8.30E-06	2.04E+04	3.20E-01
Cresol, p-	106-44-5	O	108.14	3.99E-05	1.15E+02	1.63E+00	7.40E-02	1.00E-05	2.30E+04	1.30E-01
Crotonaldehyde	123-73-9	O	70.09	8.15E-04	3.99E+00	3.27E-02	9.37E-02	1.02E-05	1.60E+05	1.90E+01
Cumene	98-82-8	O	120.19	6.07E-01	2.81E+03	6.93E+01	6.50E-02	7.10E-06	5.00E+01	4.60E+00
Cyanide	57-12-5	I	26.02	CE	2.03E-01	9.90E+00	5.21E-01	2.28E-05	1.00E+05	1.38E+01
Cyanogen	460-19-5	O	52.04	2.06E-01	1.17E+00	2.72E-02	2.04E-01	1.37E-05	1.00E+04	3.88E+03
Cyclohexanone	108-94-1	O	98.14	4.99E-04	1.34E+01	1.10E-01	7.72E-02	8.73E-06	2.30E+04	4.00E+00
Cyclotrimethylenetrinitramine	121-82-4	O	222.12	4.99E-04	7.41E+00	1.26E+00	6.65E-02	6.39E-06	3.87E+01	1.00E-09
DDD	72-54-8	O	320.05	1.66E-04	7.47E+05	1.70E+03	1.69E-02	4.76E-06	9.00E-02	8.66E-07
DDE	72-55-9	O	241.93	8.73E-04	9.90E+05	2.19E+03	1.44E-02	5.87E-06	6.50E-02	5.66E-06
DDT	50-29-3	O	354.49	2.23E-03	6.23E+06	2.75E+03	1.37E-02	4.95E-06	3.10E-03	3.93E-07
Di-n-butyl phthalate	84-74-2	O	278.35	5.94E-05	4.07E+04	6.78E+02	4.38E-02	7.86E-06	1.12E+01	4.25E-05
Di-n-octyl phthalate	117-84-0	O	390.56	2.78E-03	3.46E+08	1.66E+06	1.51E-02	3.90E-06	2.00E-02	4.47E-06
Diallate	2303-16-4	O	270.22	1.58E-04	1.19E+04	3.80E+01	8.00E-02	8.00E-06	1.40E+01	1.50E-04
Diazinon	333-41-5	O	304.35	4.70E-06	7.31E+03	2.64E+00	1.80E-02	4.90E-06	4.00E+01	8.40E-05
Dibenz-a,h-anthracene	53-70-3	O	278.35	4.66E-07	4.98E+06	3.81E+04	2.00E-02	5.18E-06	5.00E-04	2.10E-11
Dibromo-3-chloropropane, 1,2-	96-12-8	O	236.33	8.31E-03	4.81E+02	3.40E+00	8.00E-02	8.00E-06	1.00E+03	7.60E-01
Dibromochloromethane	124-48-1	O	208.28	3.25E-02	5.01E+01	1.26E+00	1.96E-02	1.05E-05	5.25E+03	1.50E+01
Dicamba	1918-00-9	O	209.03	3.28E-07	1.39E+02	4.40E-02	6.02E-02	6.69E-06	5.60E+03	9.70E-05
Dichlorobenzene, 1,2-	95-50-1	O	147.00	8.73E-02	1.91E+03	1.38E+01	6.90E-02	7.90E-06	1.50E+02	1.36E+00
Dichlorobenzene, 1,4-	106-46-7	O	147.00	1.17E-01	1.91E+03	1.29E+01	6.90E-02	7.90E-06	7.38E+01	1.06E+00
Dichlorobenzidine, 3,3-	91-94-1	O	253.13	8.65E-07	1.63E+03	1.45E+01	1.94E-02	6.74E-06	3.11E+00	2.20E-07
Dichloro-2-butene, 1,4	764-41-0	O	125.00	1.24E-02	3.97E+02	3.64E+00	7.43E-02	8.62E-06	6.91E+03	1.26E+01

Attachment E:
Chemical/Physical Properties

Chemical of Concern	CAS	Type	MW *(g/mole)*	H ' *(unitless)*	K_{ow} *(unitless)*	K_d *(unitless)*	D_{air} *(cm^2/s)*	D_{wat} *(cm^2/s)*	Solubility *(mg/l)*	Vapor Pressure *(mm Hg)*
Dichlorodifluoromethane	75-71-8	O	120.91	1.67E+01	6.54E+01	2.58E+00	5.20E-02	1.05E-05	2.80E+02	4.80E+03
Dichloroethane, 1,1-	75-34-3	O	98.96	2.39E-01	5.73E+01	6.32E-01	7.42E-02	1.05E-05	5.50E+03	2.28E+02
Dichloroethane, 1,2-	107-06-2	O	98.96	5.32E-02	6.79E+01	3.48E-01	1.04E-01	9.90E-06	8.70E+03	8.13E+01
Dichloroethylene, 1,1-	75-35-4	O	96.94	1.06E+00	1.30E+02	1.29E+00	9.00E-02	1.04E-05	2.40E+03	5.91E+02
Dichloroethylene, cis-1,2-	156-59-2	O	96.94	1.87E-01	7.24E+01	5.80E-01	7.35E-02	1.13E-05	4.93E+03	1.75E+02
Dichloroethylene, trans-1,2	156-60-5	O	96.94	3.90E-01	1.17E+02	1.00E+00	7.07E-02	1.19E-05	6.30E+03	3.52E+02
Dichlorophenol, 2,4-	120-83-2	OA	163.00	1.31E-04	6.34E+02	1.44E+00	3.46E-02	8.77E-06	4.50E+03	7.15E-02
Dichlorophenoxyacetic acid, 2,4-	94-75-7	O	221.04	5.82E-09	4.14E+02	1.78E+01	5.90E-02	6.50E-06	8.90E+02	2.40E-05
Dichloropropane, 1,2	78-87-5	O	112.99	1.17E-01	1.78E+02	1.18E+00	7.82E-02	8.73E-06	2.80E+03	5.00E+01
Dichloro-1-propanol, 2,3-	616-23-9	O	128.99	3.97E-05	6.09E+00	6.78E-01	4.84E-02	9.84E-06	2.95E+05	5.82E-01
Dichloropropene, 1,3-	542-75-6	O	110.97	1.23E-01	5.62E+01	1.05E+00	6.26E-02	1.00E-05	1.55E+03	3.12E+01
Dichlorvos	62-73-7	O	220.98	3.98E-05	2.51E+01	7.78E+07	2.32E-02	7.80E-06	1.60E+04	5.27E-02
Dieldrin	60-57-1	O	380.91	1.11E-04	2.80E+05	4.28E+02	1.25E-02	4.74E-06	1.95E-01	9.96E-07
Diethylhexyl adipate	103-23-1	O	370.57	9.78E-01	1.30E+08	7.60E+03	3.56E-02	3.72E-06	1.71E-03	8.25E-05
Diethyl phthalate	84-66-2	O	222.24	1.87E-05	4.42E+02	3.03E+00	2.56E-02	6.35E-06	1.08E+03	1.65E-03
Diethylstilbestrol	56-53-1	O	268.36	2.62E-13	4.37E+05	1.50E+03	4.43E-02	8.00E-06	1.30E+04	1.06E-09
Dimethoate	60-51-5	O	229.26	2.58E-09	1.90E+00	8.53E-02	8.00E-02	8.00E-06	2.50E+04	5.09E-06
Dimethoxybenzidine, 3,3'-	119-90-4	O	244.29	1.66E-08	1.22E+02	1.21E+00	2.42E-02	5.50E-06	2.40E+02	2.50E-07
Dimethylbenzidine, 3,3'-	119-93-7	O	212.29	5.40E-09	1.04E+03	3.99E+00	5.10E-02	8.00E-06	2.40E+02	3.70E-07
Dimethyl phenol, 2,4-	105-67-9	O	122.17	8.31E-05	4.05E+02	2.35E+00	5.84E-02	8.69E-06	6.20E+03	1.26E-01
Dinitrobenzene, 1,3-	99-65-0	O	168.11	4.57E-06	4.25E+01	6.00E-01	2.80E-01	7.60E-06	5.40E+02	2.49E-04
Dinitrobenzene, 1,4-	100-25-4	O	168.11	4.44E-06	4.25E+01	5.24E-01	6.15E-02	7.18E-06	1.00E+02	4.83E-05
Dinitrophenol, 2,4-	51-28-5	OA	184.11	2.01E-07	5.32E+01	2.00E-04	2.73E-02	9.06E-06	5.80E+03	1.14E-04
Dinitrotoluene, 2,4-	121-14-2	O	182.14	3.60E-05	1.50E+02	1.03E+00	2.03E-01	7.06E-06	2.85E+02	1.74E-04
Dinitrotoluene, 2,6-	606-20-2	O	182.14	3.11E-05	1.50E+02	8.34E-01	3.27E-02	7.26E-06	1.82E+02	5.70E-04
Dinoseb	88-85-7	O	240.22	2.08E-02	4.71E+03	2.40E+01	2.25E-02	6.25E-06	5.20E+01	7.52E-02
Dioxane, 1,4-	123-91-1	O	88.11	2.04E-04	4.79E-01	1.08E-02	2.30E-01	1.00E-05	9.00E+05	3.80E+01

Attachment E:
Chemical/Physical Properties

Chemical of Concern	CAS	Type	MW *(g/mole)*	H ' *(unitless)*	K_{ow} *(unitless)*	K_d *(unitless)*	D_{air} *(cm^2/s)*	D_{wat} *(cm^2/s)*	Solubility *(mg/l)*	Vapor Pressure *(mm Hg)*
Diphenylamine	122-39-4	O	169.23	1.83E-04	1.96E+03	6.93E+00	6.80E-02	6.30E-06	3.00E+02	4.26E-03
Diphenylhydrazine, 1,2-	122-66-7	O	184.24	1.42E-07	1.14E+03	1.32E+01	5.62E-02	5.70E-06	1.84E+03	2.60E-05
Diquat dibromide	85-00-7	O	344.05	2.69E-12	1.50E-03	4.10E+00	5.52E-02	5.52E-06	7.00E+05	1.00E-07
Disulfoton	298-04-4	O	274.41	2.58E-04	7.21E+03	1.78E+02	8.00E-02	8.00E-06	1.60E+01	2.30E-04
Diuron	330-54-1	O	233.10	3.04E-08	4.71E+02	8.53E+00	5.40E-02	5.30E-06	4.20E+01	1.00E-07
Endosulfan	115-29-7	O	406.93	4.66E-04	6.90E+03	1.48E+01	1.15E-02	4.55E-06	5.10E-01	9.96E-06
Endothall	145-73-3	O	230.13	1.08E-08	7.81E+01	1.70E+00	CE	CE	1.00E+05	1.80E-04
Endrin	72-20-8	O	380.91	4.95E-05	2.80E+05	1.87E+02	1.25E-02	4.74E-06	2.50E-01	5.84E-07
Epichlorohydrin	106-89-8	O	92.53	1.37E-03	4.23E+00	3.99E-02	8.60E-02	9.80E-06	6.60E+04	1.67E+01
Ethion	563-12-2	O	384.48	2.87E-05	5.57E+04	3.08E+02	CE	CE	1.20E+00	1.50E-06
Ethoxy ethanol, 2-	110-80-5	O	90.12	2.13E+00	3.84E-01	1.60E-02	9.47E-02	9.75E-06	1.20E+01	4.56E+00
Ethyl acetate	141-78-6	O	88.11	5.57E-03	7.31E+00	1.05E-01	7.30E-02	9.70E-06	7.90E+04	9.41E+01
Ethyl acrylate	140-88-5	O	100.12	1.06E-02	1.66E+01	2.14E+00	7.40E-02	8.68E-06	2.00E+04	2.95E+01
Ethyl benzene	100-41-4	O	106.17	3.28E-01	1.07E+03	4.08E+00	7.50E-02	7.80E-06	1.69E+02	9.60E+00
S-Ethyl dipropylthiocarbamate	759-94-4	O	189.32	4.57E-03	1.04E+03	4.80E+00	5.35E-02	5.65E-06	3.70E+02	1.60E-01
Ethyl ether	60-29-7	O	74.12	2.70E-02	1.12E+01	1.52E-01	7.40E-02	9.30E-06	6.10E+04	5.40E+02
Ethyl methacrylate	97-63-2	O	114.14	6.65E-03	5.84E+01	7.40E-01	8.00E-02	8.00E-06	1.90E+04	1.75E+01
Ethyl-2-methylbenzene, 1-	611-14-3	O	120.19	2.19E-01	3.39E+03	2.15E+01	6.76E-02	7.29E-06	7.46E+01	2.48E+00
Ethyl-4-methylbenzene, 1-	622-96-8	O	120.19	3.27E-01	3.80E+03	2.34E+01	6.70E-02	7.18E-06	9.49E+01	2.95E+00
Ethylenediamine	107-15-3	O	60.10	7.19E-08	2.41E-02	9.42E-02	1.53E-01	1.12E-05	7.95E+06	1.10E+01
Ethylene dibromide	106-93-4	O	187.86	2.93E-02	1.02E+02	1.07E+00	2.17E-02	1.90E-05	4.32E+03	1.10E+01
Ethylene glycol	107-21-1	O	62.07	2.49E-06	6.32E-02	2.52E-03	1.08E-01	1.22E-05	1.00E+06	7.00E-02
Ethylene oxide	75-21-8	O	44.05	4.92E-03	9.01E-01	4.40E-02	1.04E-01	1.45E-05	3.83E+05	1.32E+03
Ethylene thiourea	96-45-7	O	102.16	4.99E-05	3.23E-01	4.38E-03	7.15E-02	1.02E-05	1.20E+04	8.36E-02
Fluoranthene	206-44-0	O	202.26	3.88E-04	8.57E+04	9.80E+02	3.02E-02	6.35E-06	2.60E-01	8.13E-06
Fluorene	86-73-7	O	166.22	2.64E-03	1.04E+04	1.52E+02	3.63E-02	7.88E-06	1.98E+00	3.24E-03
Fluorine (soluble Fluoride)	7782-41-4	I	38.00	CE	1.67E+00	1.50E+02	CE	CE	NA/reacts	7.60E+02

Attachment E:
Chemical/Physical Properties

Chemical of Concern	CAS	Type	MW *(g/mole)*	H ' *(unitless)*	K_{ow} *(unitless)*	K_d *(unitless)*	D_{air} *(cm^2/s)*	D_{wat} *(cm^2/s)*	Solubility *(mg/l)*	Vapor Pressure *(mm Hg)*
Formaldehyde	50-00-0	O	30.03	1.37E-05	2.24E+00	4.38E-02	1.80E-01	2.00E-05	5.50E+05	3.88E+03
Formic acid	64-18-6	O	46.03	1.79E-04	3.46E-01	5.77E-03	7.90E-02	1.40E-06	1.00E+06	4.10E+01
Furan	110-00-9	O	68.08	2.24E-01	2.31E+01	4.18E-01	1.04E-01	1.20E-05	1.00E+04	6.00E+02
Fufural	98-01-1	O	96.09	1.25E-04	6.80E+00	5.57E-02	8.72E-02	1.12E-05	8.60E+04	2.00E+00
Glycidylaldehyde	765-34-4	O	72.06	1.08E-05	7.63E-01	1.84E-01	9.64E-02	1.16E-05	8.55E+07	2.70E+01
Heptachlor	76-44-8	O	373.32	2.44E-02	1.61E+06	2.35E+02	1.12E-02	5.69E-06	1.80E-01	3.26E-04
Heptachlor epoxide	1024-57-3	O	389.32	3.45E-04	8.04E+04	1.45E+02	1.32E-02	4.23E-06	2.75E-01	4.34E-06
Hexachlorobenzene	118-74-1	O	284.78	2.22E-02	7.24E+05	5.64E+02	5.42E-02	5.91E-06	6.00E-03	1.23E-05
Hexachloro-1,3-butadiene	87-68-3	O	260.76	9.94E-01	5.21E+04	1.38E+02	5.61E-02	6.16E-06	2.55E+00	1.77E-01
Hexachlorocyclohexane, alpha	319-84-6	O	290.83	2.82E-04	1.81E+04	2.64E+01	1.42E-02	7.34E-06	2.00E+00	4.26E-05
Hexachlorocyclohexane, beta	319-85-7	O	290.83	1.44E-05	1.81E+04	2.76E+01	1.42E-02	7.34E-06	5.42E-01	4.90E-07
Hexachlorocyclohexane, gamma	58-89-9	O	290.83	1.41E-04	1.81E+04	2.19E+01	1.42E-02	7.34E-06	5.75E+00	3.72E-05
Hexachlorocyclohexane, techn	608-73-1	O	290.83	5.99E-05	1.81E+04	4.80E+01	1.42E-02	7.34E-06	4.35E+01	1.64E-04
Hexachlorocyclopentadiene	77-47-4	O	273.78	7.15E-01	4.22E+04	1.91E+02	1.61E-02	7.21E-06	1.80E+00	7.32E-02
Hexachloroethane	67-72-1	O	236.74	1.62E-01	1.08E+04	3.64E+01	2.50E-03	6.80E-06	5.00E+01	4.72E-01
Hexachlorophene	70-30-4	O	406.91	2.54E-09	8.36E+06	4.00E+05	8.00E-02	8.00E-06	3.00E-03	2.74E-12
Hexane, n-	110-54-3	O	86.18	4.66E+01	1.94E+03	9.57E+00	2.00E-01	7.77E-06	1.30E+01	1.52E+02
Hexazinone	51235-04-2	O	252.32	8.62E-11	1.42E+02	7.40E-01	5.08E-02	5.11E-06	3.30E+04	2.03E-07
Hydrazine	302-01-2	O	32.05	7.20E-08	3.41E-02	2.00E-03	4.16E-01	1.90E-05	3.41E+08	1.40E+01
Indeno-(1,2,3-cd)-pyrene	193-39-5	O	276.34	2.85E-06	4.98E+06	6.93E+04	1.90E-02	5.66E-06	3.75E-03	1.40E-10
Isobutyl alcohol	78-83-1	O	74.12	4.99E-04	5.85E+00	1.12E-01	8.60E-02	8.00E-06	9.49E+04	1.00E+01
Isophorone	78-59-1	O	138.21	2.57E-04	4.15E+02	6.04E-01	6.23E-02	6.76E-06	1.20E+04	4.10E-01
Kepone	143-50-0	O	490.64	1.04E-06	8.05E+04	5.40E+02	4.22E-02	4.30E-06	7.60E+00	2.25E-07
Lead	7439-92-1	M	207.20	0.00E+00	5.36E+00	1.00E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Malathion	121-75-5	O	330.36	9.98E-07	1.94E+02	5.77E+00	1.50E-02	4.40E-06	1.45E+02	7.90E-06
Maleic anhydride	108-31-6	O	98.06	8.31E-06	4.16E+01	5.14E-01	9.50E-02	1.11E-05	8.65E+02	1.34E-03
Maleic hydrazide	123-33-1	O	112.09	1.03E-10	1.30E-01	5.00E-01	8.75E-02	8.75E-06	6.00E+03	7.50E-08

Attachment E:
Chemical/Physical Properties

Chemical of Concern	CAS	Type	MW *(g/mole)*	H ' *(unitless)*	K_{ow} *(unitless)*	K_d *(unitless)*	D_{air} *(cm^2/s)*	D_{wat} *(cm^2/s)*	Solubility *(mg/l)*	Vapor Pressure *(mm Hg)*
Malononitrile	109-77-3	O	66.06	1.97E-07	6.63E-01	9.80E-02	9.97E-02	1.09E-05	6.96E+06	3.79E-01
Manganese	7439-96-5	M	54.94	0.00E+00	1.00E+00	5.01E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mercury	7439-97-6	M	200.59	4.74E-01	3.38E-01	5.20E+01	3.07E-02	6.30E-06	3.00E-02	1.30E-03
Methacrylonitrile	126-98-7	O	67.09	3.03E-03	5.71E+00	6.78E-02	8.00E-02	8.00E-06	2.50E+04	6.80E+01
Methanol	67-56-1	O	32.04	1.94E-04	2.33E-01	3.64E-03	1.50E-01	1.64E-05	1.00E+06	1.22E+02
Methomyl	16752-77-5	O	162.21	7.48E-09	4.07E+00	3.20E+00	4.07E-02	7.20E-06	5.80E+04	5.00E-05
Methoxychlor	72-43-5	O	345.65	6.57E-04	4.65E+05	1.55E+03	1.56E-02	4.46E-06	4.50E-02	1.23E-06
Methoxyethanol	109-86-4	O	76.10	1.28E+00	1.24E-01	1.71E-01	9.15E-02	1.02E-05	2.01E+01	6.20E+00
Methyl ethyl ketone	78-93-3	O	72.11	1.94E-03	1.80E+00	3.80E-02	8.08E-02	9.80E-06	2.40E+05	9.10E+01
Methyl isobutyl ketone	108-10-1	O	100.16	5.82E-03	1.46E+01	3.00E-01	7.50E-02	7.80E-06	1.90E+04	1.45E+01
Methyl mercury	22967-92-6	I	215.62	CE	1.19E+00	---	CE	CE	CE	CE
Methyl methacrylate	80-62-6	O	100.12	1.33E-02	1.88E+01	4.60E-01	7.70E-02	8.60E-06	1.60E+04	3.80E+01
Methyl naphthalene, 2-	91-57-6	O	142.20	1.85E-02	5.20E+03	8.63E+01	6.29E-02	7.20E-06	2.54E+01	6.75E-02
Methyl parathion	298-00-0	O	263.21	5.82E-06	5.61E+02	1.30E+01	8.00E-02	8.00E-06	5.00E+01	1.52E-05
Methylene-bis (2-chloroaniline), 4,4'-	101-14-4	O	267.16	1.40E-05	2.95E+03	1.58E+02	1.99E-02	5.80E-06	7.24E+01	6.94E-05
Methylene chloride	75-09-2	O	84.93	9.10E-02	2.19E+01	2.35E-01	1.01E-01	1.17E-05	1.54E+04	4.55E+02
Molinate	2212-67-1	O	187.31	5.25E-05	8.05E+02	1.00E+00	5.65E-02	6.00E-06	9.00E+02	5.60E-03
Molybdenum	7439-98-7	M	95.94	0.00E+00	1.00E+00	2.00E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MTBE	1634-04-4	O	88.15	2.44E-02	2.69E+01	2.83E-01	7.92E-02	9.41E-05	4.80E+04	2.49E+02
Naled	300-76-5	O	380.78	2.71E-03	4.02E+01	2.66E+00	CE	6.80E-06	1.50E+00	2.00E-04
Naphthalene	91-20-3	O	128.17	2.00E-02	1.48E+03	3.10E+01	5.90E-02	7.50E-06	3.14E+01	8.89E-02
Nickel and compounds (soluble salts)	7440-02-0	M	58.69	0.00E+00	2.69E-01	1.60E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nitrate	14797-55-8	I	62.00	CE	1.62E+00	---	CE	CE	CE	CE
Nitrite	14797-65-0	I	46.01	CE	1.14E+00	---	CE	CE	CE	CE
Nitroaniline 2-	88-74-4	O	138.13	2.08E-05	1.04E+02	5.38E-01	5.99E-02	7.18E-06	1.26E+03	4.75E-03
Nitrobenzene	98-95-3	O	123.11	8.56E-04	6.47E+01	2.64E+00	7.60E-02	8.60E-06	1.90E+03	2.44E-01
Nitropropane, 2-	79-46-9	O	89.09	5.15E-03	7.44E+00	7.00E-02	9.23E-02	1.01E-05	1.70E+04	1.82E+01

Attachment E:
Chemical/Physical Properties

Chemical of Concern	CAS	Type	MW *(g/mole)*	H ' *(unitless)*	K_{ow} *(unitless)*	K_d *(unitless)*	D_{air} *(cm^2/s)*	D_{wat} *(cm^2/s)*	Solubility *(mg/l)*	Vapor Pressure *(mm Hg)*
Nitroso-n-ethylurea, n-	759-73-9	O	117.11	1.05E-04	9.45E-01	6.47E-01	8.08E-02	8.25E-06	4.85E+04	7.97E-01
Nitroso-methyl-ethyl-amine, n-	10595-95-6	O	88.11	3.70E-05	7.12E-01	4.20E-01	8.00E-02	8.00E-06	3.00E+05	2.28E+00
Nitrosodi-n-butylamine, n-	924-16-3	O	158.24	3.58E-03	2.03E+02	4.60E+00	8.00E-02	8.00E-06	1.20E+03	2.89E-01
Nitrosodi-n-propylamine, n-	621-64-7	O	130.19	9.35E-05	2.25E+01	3.94E-01	5.45E-02	8.17E-06	9.89E+03	4.00E-01
Nitrosodiethanolamine	1116-54-7	O	134.14	2.05E-09	5.25E-02	5.98E-02	7.27E-02	7.70E-06	7.33E+07	5.00E-04
Nitrosodiethylamine, N-	55-18-5	O	102.14	3.60E-05	2.21E+00	6.00E-02	8.00E-02	8.00E-06	1.47E+05	1.42E+00
Nitrosodimethylamine, N-	62-75-9	O	74.08	2.16E-05	2.30E-01	7.20E-02	1.34E-01	9.72E-06	1.00E+06	5.37E+00
Nitrosodiphenylamine	86-30-6	O	198.22	2.08E-04	1.45E+03	6.62E+00	3.12E-02	6.35E-06	3.51E+01	9.88E-02
Nitrosopyrrolidine, n-	930-55-2	O	100.12	7.48E-07	1.70E+00	1.30E-02	8.00E-02	8.00E-06	7.80E+05	1.75E-01
Nitrotoluene, m	99-08-1	O	137.14	2.24E-03	2.28E+02	2.81E+00	6.42E-02	7.69E-06	4.98E+02	1.50E-01
Nitrotoluene, o	88-72-2	O	137.14	1.87E-03	2.28E+02	2.81E+00	6.47E-02	7.73E-06	6.00E+02	1.50E-01
Nitrotoluene, p	99-99-0	O	137.14	2.29E-03	2.28E+02	2.81E+00	6.40E-02	7.70E-06	4.00E+02	1.20E-01
Octamethylpryrophosphoramide	152-16-9	O	286.25	1.16E-08	9.84E-02	6.20E-03	8.00E-02	8.00E-06	1.00E+06	9.88E-04
Oxamyl	23135-22-0	O	219.26	1.60E-11	6.32E-02	1.00E-01	5.57E-02	5.75E-06	2.80E+05	3.83E-07
Parathion	56-38-2	O	291.26	2.37E-05	5.38E+03	1.12E+02	1.70E-02	5.80E-06	1.18E+01	1.73E-05
Pebulate	1114-71-2	O	203.35	9.85E-04	3.23E+03	8.60E+00	5.10E-02	5.38E-06	9.20E+01	8.85E-03
Pentachlorobenzene	608-93-5	O	250.34	3.16E-02	1.64E+05	6.32E+02	6.70E-02	6.30E-06	6.50E-01	1.67E-03
Pentachloronitrobenzene	82-68-8	O	295.34	2.57E-02	1.08E+05	2.60E+02	1.59E-02	6.10E-06	7.11E-02	1.13E-04
Pentachlorophenol	87-86-5	OA	266.34	1.16E-05	5.44E+04	8.20E+00	5.60E-02	6.10E-06	1.40E+01	1.70E-05
Phenanthrene	85-01-8	O	178.23	5.40E-03	2.21E+04	2.83E+02	3.33E-02	7.47E-06	9.94E-01	6.80E-04
Phenol	108-95-2	O	94.11	2.47E-05	3.26E+01	3.48E-01	8.20E-02	9.10E-06	8.70E+04	4.63E-01
Phenyl mercuric acetate	62-38-4	O	336.74	3.41E-09	7.76E+00	3.20E+00	8.00E-02	8.00E-06	4.37E+03	3.04E-06
Phenylene diamine, m-	108-45-2	O	108.14	9.56E-07	4.06E-01	2.20E-02	6.63E-02	9.90E-06	3.51E+05	2.28E-02
Phenylene diamine, p-	106-50-3	O	108.14	5.24E-08	4.06E-01	2.20E-02	7.15E-02	8.92E-06	3.80E+04	4.60E-03
Phorate	298-02-2	O	260.38	4.99E-04	2.33E+03	1.10E+02	8.00E-02	8.00E-06	4.40E+01	1.30E-03
Phosphine	7803-51-2	I	34.00	1.46E+02	5.36E-01	---	3.81E-01	1.82E-05	4.00E+02	3.14E+04
Phosphorus, white	7723-14-0	I	123.90	5.65E-02	1.20E+03	2.24E+01	CE	CE	3.00E+00	2.50E-02

Attachment E:
Chemical/Physical Properties

Chemical of Concern	CAS	Type	MW *(g/mole)*	H ' *(unitless)*	K_{ow} *(unitless)*	K_d *(unitless)*	D_{air} *(cm^2/s)*	D_{wat} *(cm^2/s)*	Solubility *(mg/l)*	Vapor Pressure *(mm Hg)*
Phthalic anhydride	85-44-9	O	148.12	2.54E-07	1.17E+02	1.59E+00	6.36E-02	7.90E-06	6.20E+03	2.00E-04
Polybrominated biphenyls	67774-32-7	O	627.59	1.62E-04	2.45E+06	4.28E+01	CE	4.63E-06	1.10E-02	5.20E-08
Polychlorinated biphenyls	1336-36-3	O	290.00	1.75E-02	2.00E+06	1.06E+04	1.04E-01	1.00E-05	5.55E-02	7.60E-05
Pronamide	23950-58-5	O	256.13	3.74E-04	3.76E+03	4.00E+00	8.00E-02	8.00E-06	1.50E+01	4.00E-04
Propargite	2312-35-8	O	350.48	1.44E-06	5.37E+03	1.12E+02	3.94E-02	4.20E-06	5.00E-01	4.48E-08
Propargyl alcohol	107-19-7	O	56.06	1.34E-05	3.79E-01	1.08E-01	1.04E-01	1.24E-05	5.57E+06	1.20E+01
Propham	122-42-9	O	179.22	5.30E-06	4.57E+02	1.02E+00	5.71E-02	6.28E-06	2.50E+02	1.35E-04
Propylene oxide	75-56-9	O	58.08	3.47E-03	1.07E+00	2.53E-02	1.04E-01	1.16E-05	4.76E+05	5.32E+02
Pyrene	129-00-0	O	202.26	4.57E-04	8.57E+04	7.60E+02	2.72E-02	7.24E-06	1.35E-01	4.25E-06
Pyridine	110-86-1	O	79.10	2.91E-01	6.38E+00	8.80E-02	9.10E-02	7.60E-06	3.00E+02	2.00E+01
Quinoline	91-22-5	O	129.16	1.15E-04	1.39E+02	1.14E+01	5.46E-02	8.31E-06	6.78E+03	9.60E-02
Selenium	7782-49-2	M	78.96	0.00E+00	1.73E+00	2.20E+00	CE	CE	0.00E+00	0.00E+00
Selenourea	630-10-4	O	118.98	CE	2.35E-03	---	CE	CE	CE	CE
Silver	7440-22-4	M	107.87	0.00E+00	1.00E+00	1.00E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sodium diethyldithiocarbamate	148-18-5	O	171.26	CE	1.86E+00	---	CE	CE	CE	CE
Strychnine	57-24-9	O	334.42	6.65E-12	7.04E+01	1.58E+00	8.00E-02	8.00E-06	1.43E+02	1.67E-10
Styrene	100-42-5	O	104.15	1.14E-01	7.85E+02	1.52E+01	7.10E-02	8.00E-06	3.10E+02	6.24E+00
TCDDioxins, 2,3,7,8-	1746-01-6	O	321.97	1.47E-03	1.05E+07	2.83E+05	4.70E-02	8.00E-06	1.93E-05	7.40E-10
Tetrachlorobenzene, 1,2,4,5-	95-94-3	O	215.89	4.99E-02	3.72E+04	3.20E+01	2.11E-02	8.80E-06	3.00E-01	5.40E-03
Tetrachloroethane, 1,1,1,2-	630-20-6	O	167.85	9.98E-02	8.57E+02	1.91E+01	7.10E-02	7.90E-06	1.10E+03	1.22E+01
Tetrachloroethane, 1,1,2,2-	79-34-5	O	167.85	1.55E-02	1.56E+02	1.55E+00	7.10E-02	7.90E-06	2.97E+03	5.17E+00
Tetrachloroethylene	127-18-4	O	165.83	7.65E-01	9.23E+02	3.10E+00	7.20E-02	8.20E-06	2.00E+02	1.84E+01
Tetrachlorophenol, 2,3,4,6-	58-90-2	OA	231.89	2.54E-04	1.23E+04	2.10E+00	2.17E-02	7.10E-06	1.00E+02	5.02E-03
Tetraethyl dithiopyrophosphate	3689-24-5	O	322.32	1.75E-04	9.56E+03	1.48E+01	1.50E-02	5.50E-06	2.50E+01	1.70E-04
Tetraethyl lead	78-00-2	O	323.45	3.31E+00	7.63E+04	9.80E+01	1.32E-02	6.40E-06	8.00E-01	1.50E-01
Thallium chloride	7791-12-0	I	239.84	0.00E+00	---	---	CE	CE	2.90E+03	0.00E+00
Thiofanox	39196-18-4	O	218.32	3.90E-07	1.44E+02	1.18E+00	2.55E-02	6.62E-06	5.20E+03	3.10E-04

Attachment E:
Chemical/Physical Properties

Chemical of Concern	CAS	Type	MW *(g/mole)*	H ' *(unitless)*	K_{ow} *(unitless)*	K_d *(unitless)*	D_{air} *(cm^2/s)*	D_{wat} *(cm^2/s)*	Solubility *(mg/l)*	Vapor Pressure *(mm Hg)*
Thiophanatemethyl	23564-05-8	O	342.40	3.82E-07	3.16E+01	1.80E-01	4.55E-02	4.68E-06	3.50E+00	7.50E-08
Thiram	137-26-8	O	240.44	3.28E-06	5.05E+01	1.34E+01	2.25E-02	6.24E-06	3.00E+01	7.50E-06
Tin	7440-31-5	M	118.71	0.00E+00	1.95E+01	---	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Toluene	108-88-3	O	92.14	2.76E-01	3.47E+02	2.80E+00	8.70E-02	8.60E-06	5.30E+02	2.82E+01
Toluenediamine, 2,4-	95-80-7	O	122.17	7.48E-08	1.43E+00	2.58E+01	8.00E-02	8.00E-06	7.47E+03	8.36E-05
Toluenediamine, 2,6-	823-40-5	O	122.17	5.15E-10	1.43E+00	---	6.87E-02	7.97E-06	4.80E+04	1.98E-05
Toluene diisocyanate, 2,4/2,6-	26471-62-5	O	174.16	6.86E-06	5.50E+03	4.51E+01	6.09E-02	6.80E-06	1.11E+05	8.00E-02
Toluidine, p-	106-49-0	O	107.16	3.82E-04	4.20E+01	5.00E-01	8.00E-02	8.00E-06	7.20E+03	3.30E-01
Toxaphene	8001-35-2	O	413.81	1.40E-04	6.24E+06	1.92E+03	1.16E-02	4.34E-06	7.40E-01	4.19E-06
TP Silvex, 2,4,5-	93-72-1	O	269.51	5.45E-07	4.78E+03	5.20E+01	1.94E-02	5.80E-06	1.40E+02	5.20E-06
Triallate	2303-17-5	O	304.67	4.53E-04	3.70E+04	2.88E+01	4.58E-02	4.84E-06	4.00E+00	1.20E-04
Bis (tri-n-butyltin) oxide	56-35-9	O	596.11	2.08E-03	6.25E+05	---	CE	CE	1.80E+01	6.91E-05
Trichloro-1,2,2-trifluoroethane, 1,1,2	76-13-1	O	187.38	2.20E+01	1.24E+03	2.58E+01	7.80E-02	8.20E-06	2.00E+02	3.60E+02
Trichlorobenzene, 1,2,4-	120-82-1	O	181.45	5.90E-02	8.44E+03	3.32E+01	3.00E-02	8.23E-06	4.88E+01	3.36E-01
Trichloroethane, 1,1,1-	71-55-6	O	133.40	7.15E-01	4.78E+02	2.19E+00	7.80E-02	8.80E-06	1.33E+03	1.24E+02
Trichloroethane, 1,1,2-	79-00-5	O	133.40	3.80E-02	1.03E+02	1.00E+00	7.92E-02	8.80E-06	4.42E+03	2.52E+01
Trichloroethylene	79-01-6	O	131.39	4.28E-01	2.97E+02	1.87E+00	7.90E-02	9.10E-06	1.10E+03	7.20E+01
Trichlorofluoromethane	75-69-4	O	137.37	4.03E+00	1.35E+02	2.70E+00	8.70E-02	9.70E-06	1.10E+03	6.87E+02
Trichlorophenol, 2,4,5-	95-95-4	OA	197.45	1.78E-04	2.79E+03	5.96E+00	2.91E-02	7.03E-06	1.20E+03	1.63E-02
Trichlorophenol, 2,4,6-	88-06-2	OA	197.45	3.19E-04	2.79E+03	2.62E+00	3.18E-02	6.25E-06	9.82E+02	1.18E-02
Trichlorophenoxyacetic acid, 2,4,5-	93-76-5	O	255.48	3.62E-07	1.83E+03	1.06E+00	8.00E-02	8.00E-06	2.78E+02	3.61E-06
Trichloropropane, 1,1,2-	598-77-6	O	147.43	1.21E+00	2.69E+02	3.47E+00	3.96E-02	9.30E-06	4.44E+01	6.64E+00
Trichloropropane, 1,2,3-	96-18-4	O	147.43	1.58E-02	3.19E+02	7.78E+00	7.10E-02	7.90E-06	1.90E+03	3.70E+00
Triethylamine	121-44-8	O	101.19	1.99E-02	3.25E+01	2.67E-01	7.54E-02	7.51E-06	1.50E+04	5.00E+01
Trifluralin	1582-09-8	O	335.28	2.01E-03	2.05E+05	2.74E+02	1.49E-02	4.70E-06	6.00E-01	1.10E-04
Trimethylbenzene, 1,2,3-	526-73-8	O	120.19	1.33E-01	3.55E+03	1.18E+01	6.77E-02	7.41E-06	7.52E+01	1.49E+00
Trinitrobenzene, 1,3,5-	99-35-4	O	213.11	2.87E-06	2.79E+01	2.83E-01	8.00E-02	8.00E-06	3.53E+02	9.90E-05

Attachment E:
Chemical/Physical Properties

Chemical of Concern	CAS	Type	MW *(g/mole)*	H ' *(unitless)*	K_{ow} *(unitless)*	K_d *(unitless)*	D_{air} *(cm^2/s)*	D_{wat} *(cm^2/s)*	Solubility *(mg/l)*	Vapor Pressure *(mm Hg)*
Trinitrophenylmethylnitramine, 2,4,6-	479-45-8	O	287.15	8.31E-11	1.10E+02	4.69E+00	5.69E-02	6.40E-06	7.50E+01	4.00E-10
Trinitrotoluene, 2,4,6-	118-96-7	O	227.13	1.90E-05	9.85E+01	6.04E+00	5.41E-02	6.57E-06	1.30E+02	1.24E-04
Uranium	7440-61-1	M	238.03	0.00E+00	1.00E+00	2.96E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Vanadium	7440-62-2	M	50.94	0.00E+00	1.00E+00	1.00E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Vernam	1929-77-7	O	203.35	7.36E-04	3.23E+03	5.51E+01	5.10E-02	5.39E-06	9.85E+01	1.04E-02
Vinyl acetate	108-05-4	O	86.09	2.29E-02	5.34E+00	1.05E-01	8.50E-02	9.20E-06	2.00E+04	1.09E+02
Vinyl chloride	75-01-4	O	62.50	3.49E+00	4.20E+01	2.19E-01	1.06E-01	1.23E-05	2.76E+03	2.80E+03
Warfarin	81-81-2	O	308.33	1.15E-07	1.58E+03	1.82E+01	1.63E-02	4.40E-06	1.70E+01	1.16E-07
Xylene, m-	108-38-3	O	106.17	3.05E-01	1.58E+03	3.92E+00	7.00E-02	7.80E-06	1.60E+02	8.00E+00
Xylene, o-	95-47-6	O	106.17	7.36E-04	1.35E+03	2.58E+00	8.70E-02	1.00E-05	1.78E+02	6.75E+00
Xylene, p-	106-38-3	O	106.17	3.18E-01	1.48E+03	6.18E+00	7.69E-02	8.44E-06	1.85E+02	8.76E+00
Xylenes	1330-20-7	O	106.17	2.93E-01	1.22E+03	4.80E+00	7.40E-02	8.50E-06	1.98E+02	8.06E+00
Zinc	7440-66-6	M	65.39	0.00E+00	3.38E-01	1.60E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Type - O: Organic, I: Inorganic, M: Metal, OA: Organic Acid
MW - Molecular Weight (g/mole)
H' - Dimensionless Henry's Law Constant H' = H x 41.57 @ 20ºC (cm^3-H_2O/cm^3-air)
K_{ow} - Octanol-water partition coefficient (cm^3-H_2O/cm^3-Octanol)
K_d - Soil-water partition coefficient (cm^3-H_2O/g-Soil)
D_{air} - Diffusion coefficient in air (cm^2/s)
D_{wat} - Diffusion coefficient in water (cm^2/s)

CE - Not found; cannot estimate
NA/reacts - Not applicable because reacts with water
Values in italics - Estimated by TNRCC